The design and testing of a decision support tool for the evaluation of the reusability of glass wine bottles: A South African case study

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Declaration

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March 2018

Abstract

Sustainable business is becoming increasingly important to governments and society. The South African wine industry has a good reputation as far as its contribution to sustainable business is concerned. However, this contribution is mainly represented by the production of the wine and not necessarily the post-production side. Reusing glass wine bottles is an initiative that can contribute to the wine industry's reputation on the post-production side of sustainable business.

Reusing glass wine bottles that are currently not being reused requires expensive infrastructure to viably accommodate the recovery and reusing activities. This poses large financial risks to companies that wish to reuse their glass wine bottles. Companies have to evaluate whether their glass wine bottles are viably reusable before such an initiative can be implemented in practice. This requires many factors to be taken into consideration.

This research was dedicated to developing and testing a user-friendly decision support tool to evaluate the viability of reusing glass wine bottles. The tool provides clarity on the main research objective from a business logistics perspective by taking various parameters into consideration, such as a company's environmental setting, current sales volume and the type of market the wine bottle is serving. Even though more perspectives, such as a cost-benefit analysis and an environmental sustainability analysis also have to be done, this decision support tool represents the first of the various tests a glass wine bottle should undergo before further investigation is done.

Due to the exploratory nature of this research, a case study design was followed. The case company of this research provided an ideal setting to test the decision support tool since they already have the required infrastructure in place to reuse several of their glass wine bottles. The decision support tool of this research was developed and tested based on their business environment and the available data on their reusable and non-reusable glass wine bottles.

The decision support tool was tested on one of the company's non-reusable wine bottles to provide an outcome to decision makers on its level of reusability. The tool concluded that the wine bottle is viably reusable from a business logistics perspective, although it also indicated which parameters would have to improve to increase its level of reusability. The company's decision makers evaluated the results to increase the overall validity and reliability of the research. The decision support tool's framework can also be used by the broader wine industry if companies want to evaluate whether their wine bottles are showing signs of viable reusability.

Opsomming

Volhoubare besigheid word vir owerhede en die samelewing 'n toenemend belangrike kwessie. Die Suid-Afrikaanse wynindustrie het 'n goeie reputasie met betrekking tot hulle bydrae tot volhoubare besigheid, maar hierdie bydrae word hoofsaaklik deur die produksie kant gemaak, en nie noodwendig die na-produksie kant nie. Die hergebruik van glasbottels is 'n inisiatief wat die wynindustrie kan implementeer om hulle reputasie aan die na-produksie kant te verbeter.

Die hergebruik van wynbottels wat tans nie hergebruik word nie vereis duur infrastruktuur om die herwinning en hergebruik aktiwiteite lewensvatbaar te akkommodeer. Dit hou groot finansiële risiko's in vir maatskappye wat hulle glas wynbottels wil hergebruik. Maatskappye moet 'n deeglike evaluasie doen om te verseker dat hulle wynbottels lewensvatbaar hergebruik kan word voordat so 'n inisiatief in die praktyk in werking gestel kan word.

Hierdie navorsing het ten doel gehad om 'n verbruikersvriendelike raamwerk vir besluitnemingsondersteuning te ontwikkel en te toets om die herbruikbaarheid van glas wynbottels te evalueer. Die ondersoek is benader vanuit 'n besigheid-logistieke perspektief deur verskeie parameters, soos 'n maatskappy se agtergrond, verkoopvolumes en die tipe mark wat die wynbottel dien, in ag te neem. Selfs al moet meer perspektiewe, byvoorbeeld 'n koste-voordeel analise en 'n volhoubare omgewingsanalise betrek word, verteenwoordig hierdie raamwerk die eerste van verskeie toetse wat 'n glas wynbottel moet ondergaan voordat enige verdere ondersoek gedoen word.

Weens die ondersoekende aard van die navorsing is 'n gevallestudie ontwerp gebruik om die navorsingsvraag te beantwoord. Die maatskappy wat aan die gevallestudie deelgeneem het, bied 'n ideale omgewing om die raamwerk te toets aangesien hulle reeds die nodige infrastruktuur in plek het om verskeie van hulle glas wynbottels te hergebruik. Die raamwerk vir besluitnemingsondersteuning is ontwikkel en getoets aan die hand van die besigheid se omgewing en die data rakende hulle herbruikbare en nie-herbruikbare glas wynbottels.

Die raamwerk vir besluitnemingsondersteuning is op een van die maatskappy se nie-herbruikbare wynbottels getoets. Die bevinding was dat die wynbottel wel lewensvatbaar hergebruik kan word vanuit 'n besigheid-logistieke perspektief, maar dit het ook die parameters aangedui wat verbeter moet word om die wynbottel se vlak van herbruikbaarheid te verhoog. Die maatskappy se besluitnemers het die resultate geëvalueer om die algehele geldigheid en betroubaarheid van die studie te verhoog. Die raamwerk kan ook deur die breër wynindustrie gebruik word indien maatskappye hulle wynbottels wil evalueer om tekens van lewensvatbare herbruikbaarheid na te spoor.

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Finally, I must express my very profound gratitude to God Almighty, for I will not have had the strength to finish my Master's degree while at the same time starting, running and expanding my own company with success. There were various times when I was afraid to take on large tasks, but Your plans for my life are always bigger than my own and I thank You for that.

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Table of Acronyms and Abbreviations

Acronym	Meaning
CLSC	Closed-loop supply chain
DSS	Decision support system
DST	Decision support tool
EU	European Union
FY	Financial year
GBGB	Give Back, Get Back
HoReCa	Hotel, restaurant and catering
NDA	Non-disclosure agreement
RTD	Ready-to-drink
SAB	South African Breweries
SKU	Stock-keeping unit
TGRC	The Glass Recycling Company
ZAR	South African Rand

Chapter 1 – Introduction

1.1 Background

Sustainable business is becoming an increasingly important matter for modern society and governments internationally. The South African wine industry is well known for its dedication to environmental sustainability (WOSA, 2016). However, this reputation is largely represented by the production side of the wine industry, i.e. growing and making of wine, and not necessarily the post-production side. Fortunately, there are still opportunities in the post-production side of the wine industry to strengthen its overall reputation.

The reusing of packaging is an initiative that contributes to a positive environmental effect (Saphire, 1996:2; Platt & Rowe, 2002:8; Jayaraman, Ross & Agarwal, 2008:141) when it is compared to recycling and disposing of packaging. It can also be applied to the wine industry. Reusing packaging should be a priority for companies in modern society where environmental responsibility is becoming increasingly important for consumers and governments. This should especially be considered a priority in a growing industry where the amount of packaging that is used increases on an annual basis.

Around 43% of the wine produced in South Africa is consumed in the domestic market (SAWIS, 2017:14). The domestic sales figures have been growing at an average of around 5 % per year from 2012 to 2016 (SAWIS, 2017:20). Figure 1.1 illustrates the variations of packaging that is used for wine in South Africa, as well as the growth in the local wine consumption. The figure also illustrates that glass bottles are the preferred packaging material for wine in the South African market. From the approximately 388 million litres of wine sold domestically in 2016, just under half of the wine was sold in glass containers (SAWIS, 2017).

Reusing glass bottles is not a new concept, whether internationally or domestically. South African companies in various industries that use glass bottles for packaging are reusing their containers on a commercial scale. The wine industry can learn from these practices and from the theories that literature provides on reusing.

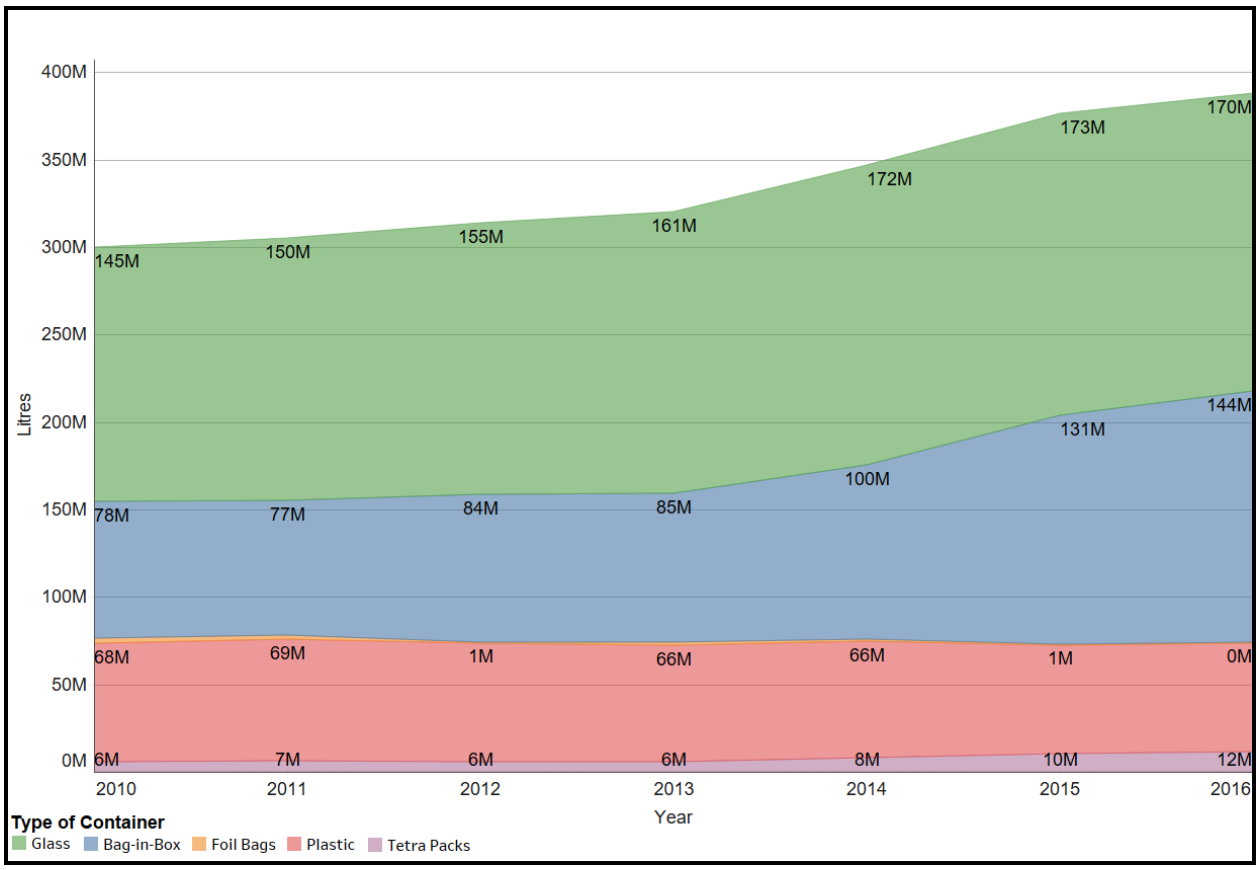


Figure 1.1: Type of containers used in the South African wine industry for natural wine in litres from the year 2010 to 2016
(Source: SAWIS, 2017)

1.2 Problem statement

Strict environmental and packaging regulations are increasingly forcing companies to be held accountable for their product's residual even long after the products have been sold (Dowlatshahi, 2000:144). Both companies and the environment can benefit if fewer product residuals are disposed. The traditional approach of many manufacturers towards end-of-life products is to ignore them (Thierry, 1995:115). This attitude has to change since large amounts of products and packaging are landfilled or incinerated, with substantial damage to the environment. Therefore, alternative methods to the disposing of packaging should seriously be considered.

The reusing of packaging is a viable alternative to disposing. However, reusing packaging, such as glass bottles, requires large investments from companies in thicker and more durable glass bottles and the infrastructure that accommodates the recovery and reuse of glass bottles. The infrastructure includes washing, sorting, palletising and dedicated storage facilities for returned bottles.

Smaller wine companies are discouraged by this large investment and the risk of not having enough returned bottles to cover the overhead costs, especially in a price sensitive industry (Conningarth Economists, 2015:3). Therefore, the companies continue their business with one-way glass wine bottles and ignore their packaging at its end-of-life stage.

Before wine companies disregard the idea of reusing their glass wine bottles due to the large investment required to develop the reusing infrastructure, they can cost-effectively evaluate the reusability of their glass wine bottles by observing some of their wine's key business parameters. These parameters include a company's environmental setting, current sales volume and the type of market the wine bottle is serving. Jointly considering these parameters can provide companies with some assurance on whether a bottle is viably reusable.

This research was based on a case study design approach. This allowed the research to test whether evaluating the reusability of a glass wine bottle based on key parameters can provide a viable outcome. A case company, Distell Limited (called Distell from here onwards), provided a great platform on which to base the research.

Distell already has the required reusing infrastructure and also reuses several of their glass bottles' packaging from a variety of their brands, which includes wine, spirits, cider and ready-to-drink (RTD) brands. Unfortunately, not all of Distell's glass bottles are being reused. One of Distell's brands in particular, called Brand X for the remainder of this research, is showing similarities to some of Distell's reusable wine bottles. This created a research opportunity to study Brand X's parameters and to compare it to Distell's other returnable wine bottles to indicate its level of reusability.

To measure a wine bottle's level of reusability, a framework called a decision support tool (DST) was developed and tested to take all the relevant parameters into consideration to derive a viable outcome. A DST, as described by Sauter (2011:13) is "a computer-based system that supports choice by assisting the decision maker in the organisation of information and modelling of outcomes". If the non-reusable glass wine bottle proves to be viably reusable, the case company can add it to its catalogue of reusable wine bottles, which will increase the company's contribution to its environmental sustainable business.

1.3 Research question

The research opportunity discussed above partly derives from the case company's strategy to improve its overall corporate responsibility performance with the focus on environmentally sustainable business (Distell, 2016:132–135). The research opportunity of this study is more tactical in nature and provided the following primary research question:

Under which business logistics circumstances is it viable to implement reusable wine bottles?

The 'circumstances' mentioned in the research question above is represented by the parameters identified in this research to determine the reusability of glass wine bottles. The word 'viable' will refer to the viability of reusing glass wine bottles from a business logistics perspective. As

mentioned in the previous subsection, a framework called a DST was developed to assist Distell's decision makers with this question.

To provide decision makers with a more holistic outcome on whether to reuse their glass wine bottles in practice, more perspectives also have to be added. The other perspectives include an economical and environmental perspective. This will be considered as opportunities for future research.

1.4 Research objectives

The title of this study is also the main research objective, i.e. designing and testing a decision support tool for the evaluation of the reusability of glass wine bottles. In order to accomplish the main research objective, the following five secondary objectives have been set out:

1. Identify key decisions and requirements regarding the reuse of glass bottles.
2. Identify all qualitative and quantitative parameters from literature and practice for testing the reusability of glass wine bottles.
3. Evaluate the various DST development frameworks to find the most suitable framework for this research.
4. Develop a DST for evaluating the reusability of glass wine bottles.
5. Test the DST at the hand of Distell's Brand X to determine the glass wine bottle's viability for reuse and make recommendations on whether to implement reusable bottles for Brand X based on the results deriving from the DST.

The first part of the secondary objectives (Objectives 1 and 2) required the key decision requirements from the case company and literature to be taken into account. The focus then shifted to glass wine bottles to identify the qualitative and quantitative parameters that are used to determine a glass wine bottle's level of reusability from a business logistics perspective. The information was primarily gained after studying company reports and conducting interviews with relevant managers within the industry. Theoretical information on the topic was gained from literature by studying relevant journal articles and previous research studies.

The second part of the secondary objectives (Objectives 3 and 4) required the researcher to evaluate the various DST frameworks provided by literature. The decision supports tool frameworks that were best aligned to answer the research question at hand were used throughout the development phase of this research. Information from the first two secondary research objectives guided the development of the DST for the research.

Only when the research objectives above were successfully executed, the final objective was achieved, and the DST could be tested. The DST is required to answer the research question to

provide more information on the business logistics circumstances that are required to implement reusable wine bottles in a viable manner.

1.5 Research design and conceptual framework

The research question requires the identification of the business logistics circumstances under which it will be viable to implement reusable wine bottles. The research process that was followed was done in four phases, as illustrated by Figure 1.2. The phases include 1) identifying the parameters for evaluating the reusability of glass wine bottles; 2) collecting data from the case company; 3) Developing a DST to evaluate the reusability of glass wine bottles, and; 4) testing the DST on non-reusable wine bottles. The research process and methodology is discussed more thoroughly in Chapter 2 of this thesis.

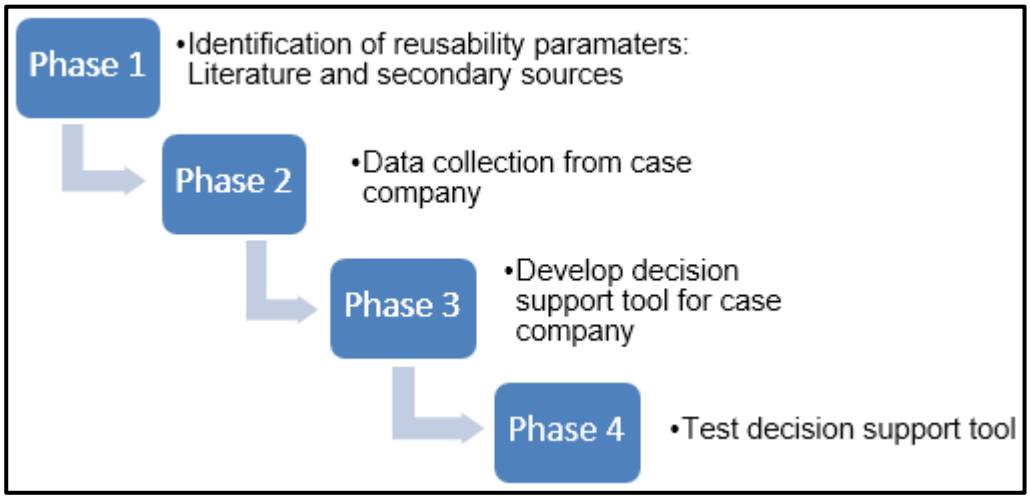


Figure 1.2: Four phases of the research methodology research process

1.6 Scope of research

This research was focused on the development of a DST to evaluate the reusability of glass wine bottles. The DST was developed based on relevant quantitative and qualitative parameters. The parameters relevant to evaluating the reusability of glass wine bottles were derived from literature as well as interviews with managers from the case company and other companies that also reuse their glass bottles.

The DST was developed based on the case company's decision needs and requirements for evaluating the reusability of glass wine bottles specifically for the South African market. Even though the DST is focused on evaluating the reusability of glass wine bottles, it can also be used to evaluate the reusability of Distell's other products such as spirits, ciders and RTDs, provided that minor adjustments to the DST are made.

The DST that was developed by this research is unfortunately limited to be used only by the case company because of their unique setting with existing infrastructure that is already in use for their

broader range of reusable glass bottles. The DST of this research was developed to make a decision on whether to add additional brands to Distell's catalogue of reusable brands rather than evaluating a brand for a company to start reusing anew.

In theory, other companies are able to enter their glass bottles' data into the DST to derive at an estimate level of reusability. However, without possessing the required infrastructure and skills to handle the recovering and reuse of glass bottles on a commercial scale, the DST deriving from this research will not be of direct benefit to them. The benefit to them would rather be that the DST identifies the business logistics parameters that they should take into consideration when assessing the feasibility of reusing glass wine bottles in South Africa.

The data that the system required had to reflect the current situation in South Africa from Distell's perspective. The quantitative data that were used within the tool primarily focused on Distell's 2015 financial year. However, some parameters took data into consideration spanning over the timeframe starting in 2011 to 2015 to indicate trends leading up to its current position.

1.7 Significance of the research

DSTs are most useful when it is not obvious what information, models or criteria are most appropriate to assist in making a decision (Sauter, 2011:18). The goal of a DST is to look at more facets of a decision, generate better alternatives and solve complex problems (Sauter, 2011:18). In the case of this research, the DST was used to assist the decision makers of Distell to decide whether to reuse non-reusable wine brands by testing it on Brand X.

The DST was useful to the case company due to the diverse and tremendous amount of information it was able to process in comparison to managers who might overlook some aspects on this important decision. It was done by comparing various parameters of Distell's reusable and one-way glass wine bottles to the same parameters of Brand X's glass wine bottle.

The outcome of the DST benefitted the case company by providing a valid and reliable answer on whether to reuse the Brand X glass wine bottle from a business logistics perspective. Even though the research concluded that Brand X should be reused, more research from different perspectives on the brand is required to provide a more holistic answer. These perspectives include an economic, environmental and optimisation perspective, which are regarded as opportunities for future research.

The additional research is required because the research question of this study is only answered from a business logistics perspective. The DST should be regarded as the first of various tests that Brand X has to undergo before a certain and final answer can be provided on whether to reuse the brand's 750 ml glass wine bottle in practice.

The three pillars of sustainability will be benefitted in the case where this research leads to an outcome that ultimately leads to the reusing of Brand X's glass wine bottles in practice. The three pillars include the economic, environmental and social pillars of sustainability.

From an economic perspective, the successful reuse of the Brand X wine bottles will lead to fewer new glass bottles to be purchased. This in turn will lead to savings in the company's bottom line. Reusing glass bottles leads to fewer bottles being disposed and landfilled, which has a positive effect on the environment. Finally, when bottles are reused, more people have to be employed to handle the recovery and reuse process in comparison to using only one-way glass bottles, which benefits the social pillar of sustainability (Golding, 1998:71).

The final DST of this research is specifically designed to evaluate the reusability of glass wine bottles. Even though the focus of the research is based on glass wine bottles, the DST of this study will also be able to evaluate the reusability of Distell's other products such as spirits, ciders and RTDs, provided that the right adjustments are made to the DST. This increases the flexibility and usefulness of the DST to the case company.

1.8 Scope of limitations

One of the factors that affected the overall quality and validity of this research was the willingness of the case company to share the required data. The data that was required for this research was considered as sensitive and therefore measures had to be taken to keep the information secure. A non-disclosure agreement (NDA) was signed to assure the case company that the information would be kept secure throughout the research.

The secureness of the quantitative data was strengthened by hiding the names of the reusable and non-reusable wine brands that was used in the DST. The names were changed to alphabetical letters.

The research was limited to one case company (Distell) and one country (the Republic of South Africa). The case company that was chosen for the research is representative of the South African wine industry to an extent by having the single largest market volume share by one company at 33% (Euromonitor International, 2015). Even though the primary focus was on the case company, managers from other companies were also interviewed throughout the research to gain their perspective on the glass bottle reusing industry within South Africa.

The nature of the DST and the depth of its analysis were influenced by the fact that the data that was provided was at an aggregate level. This required the DST to rely fully on Distell's business intelligence.

The products that formed part of the research was limited to Distell's 750 ml and 1 litre glass wine bottles, which are grouped in the same category of reusable wine bottles. Distell has additional

product lines within their spirits, ciders and RTDs, as well as different bottle sizes within their wine product line such as 1.5 litre, 2 litre and 4 litre bottles. Some of the glass bottles within the other product lines are also being reused, but data on these bottles were not used in this research study.

Using the data from the reusable bottles within the additional product lines could strengthen the overall validity of the outcome by having more products to compare the respective parameters. However, in order to compare products from the same industry to one another, Distell's managers suggested not to include Distell's brands from the spirits, ciders and RTDs in the DST (Van den Berg, 2016a).

The timeframe of the data that was gathered for the DST was limited to the 2015 financial year. Additional data ranging from the years 2011 until 2015 were also acquired to indicate sales volume trends among Distell's various wine brands. The 2015 financial year (FY) was the most recent year for which a full year's data could be provided for evaluating the reusability of glass wine bottles at the time of requesting the research data. This was taken into consideration when the research outcome was discussed with Distell's decision makers. Various matters could have changed or affected the outcome of the DST for the 2016 and 2017 financial years, the period during which the research took place, which might not have been taken into consideration.

As an addition to the limitations, the research also has exclusions. These exclusions are listed below and are perceived as future study recommendations. Doing research on the exclusions below will provide a more holistic answer to the outcome of this research.

1. Performing a cost-benefit analysis on reusing Brand X's glass wine bottle.
2. Performing a life cycle analysis on Brand X's glass wine bottle.
3. Developing a linear programming model to identify the amount of Brand X's glass wine bottles to be recovered to be viably reusable from a financial perspective.

1.9 Assumptions

This research study was done under the assumption that Distell has the necessary infrastructure in place to handle the commercial recovery and reuse of glass bottles and that current capacity could be increased to extend reuse to additional brands. Having infrastructure and a supply chain that can handle reusable glass bottles to be reused was considered a prerequisite for this research. A DST that is used by a company that does not have the necessary infrastructure in place would have a similar structure to the one used in this research, but would set different required levels for the business logistics parameters that influence viability.

The DST that was developed was based on the assumption that the reusable wine brands used within the tool were viably reusable at the time of the research. Even though some of the reusable

wine brands might not comply with Distell's required parameters for being reusable, it was assumed that having these reusable wine brands in the reusable system makes them collectively reusable. Being collectively reusable allows Distell to benefit from economies of scale with high numbers of bottles being returned across multiple brands and product ranges.

1.10 Definitions of key terminology

A broad range of definitions and terminology was used throughout this research paper concerning the design and testing of a DST for the evaluation of the reusability of glass wine bottles. There are two dominant topics within this research, the first focuses on the reuse of glass bottles, while the second is focused on the development of DSTs. The key terms and definitions of this section primarily derive from these two topics and are discussed below within the context of the main research topic.

Reverse logistics

Because the research focuses on the recovery and reuse of glass wine bottles, reverse logistics was considered an inevitable process that accommodates the recovery and reuse of glass bottles. The term reverse logistics in the context of recovering products with the intent to reuse it can be defined as the return, upstream movement of a good or material resulting from reuse, recycling or disposal (Carter & Ellram, 1998: 86). Within this research paper, the term 'reverse logistics' is also referred to as 'return logistics', 'recovery logistics', 'redistribution' and 'reverse distribution', These terms are used as they derive from literature and are not used unnecessarily in the place of 'reverse logistics',

One-way packaging

When the packaging of a product is intended to be used only once, it is referred to as one-way packaging (Kroon & Vrijens, 1995:57). The term 'one-way' packaging is also referred to as 'non-reusable' packaging and 'non-returnable' packaging in this research.

Reusable packaging

Packaging is considered reusable when it is intended to be reused multiple times before it is discarded (Kroon & Vrijens, 1995:57). Other terms for reusable packaging include 'refillable packaging' or 'returnable packaging'.

Viable

The word 'viable' is defined by the Cambridge Dictionary (2017) as "able to be done or likely to succeed". In the case of this research, the word viable refers to the viability of reusing glass wine

bottles from a business logistics perspective referring to the collection, initial storage, transport, cleaning, staging storage, up to re-entering the forward distribution process.

1.11 Brief chapter overview

This research consists of eight chapters. This subsection provides an overview of each of the chapters of this research.

Chapter 1 – Introduction

The introductory chapter provides background to the rationale of this research and states the problem that serves as motivation for this research. The research question that has been identified is discussed, followed by the research objectives that have to be executed to ensure that the research question is answered appropriately. The chapter continues with additional sections to provide a better perspective on the research.

Chapter 2 – Research methodology

The research methodology chapter starts by placing the research within perspective of Mouton's (2001) 'three worlds framework', followed by an explanation of the conceptual framework of this research. The research objectives are explained along with the research strategy that was followed to execute the research objectives. The chapter concludes by explaining the validity and reliability of the research methods that were used.

Chapter 3 – Investigation into the reuse of glass wine bottles

This chapter provides a review on literature focusing on the effects of reuse on environmental sustainability. The reusing of glass wine bottles from a business logistics perspective is also discussed. The chapter continues by focusing on international and domestic practices that companies implement to reuse their glass bottles viably. Kroon and Vrijens' (1995) reusing systems provides a theoretical perspective on the reuse of containers. Practical interviews were also used to supplement the literature review. The chapter concludes by providing literature on the aspects that motivate companies to reuse.

Chapter 4 – Literature review: DSTs

This research requires the development of a DST to evaluate the reusability of glass wine bottles. Chapter 4 discusses the literature on the various aspects of DSTs, such as the components, design approach and types of DST frameworks. The chapter concludes by discussing the design and development stages of a DST and the requirements for the data to be useful.

Chapter 5 – Case study: Distell Ltd.

Chapter 5 provides an overview of the case company on which this research was conducted. The chapter explains the rationale behind selecting Distell as the case company for this research based on their experience with reusing glass bottles. The chapter also explains why Brand X is being considered for reuse. The research opportunity that exists in working along with Distell is also summarised. The final section of this chapter discusses the information contributed by Distell to this research.

Chapter 6 – The DST

This chapter is dedicated to explaining how the methods from the Chapter 4 literature review were used to develop and construct the DST for this research. This chapter also discusses the physical construction of the DST's three components, followed by an explanation of the method of implementation. Chapter 6 concludes by explaining how the DST will be implemented and the presentation of the findings.

Chapter 7 – Discussion of findings

Chapter 7 discusses the findings and results deriving from the DST that was developed in Chapter 6. The findings from each parameter's input templates and output template is discussed, analysed and synthesised. The chapter ends by evaluating the DST's model and data component. Distell's decision makers evaluate the findings on Brand X's level of reusability as well as the rest of the DST's outcomes to increase the research's validity and reliability.

Chapter 8 – Conclusions and Recommendations

The concluding chapter of the research summarises the research findings and the conclusions. The chapter continues by discussing the limitations of the research and provides recommendations for future research. The chapter ends the research with concluding remarks from the researcher.

Chapter 2 – Research methodology

2.1. Introduction

The research methodology chapter explains the overall design that was followed to link the research objectives to the appropriate research methodology in order to answer the research question. It articulates the data that were required, the methods that were used to collect and analyse the data, and how it assisted the researcher to answer the main research question (Van Wyk, 2012).

The research question of this thesis required the identification of the business logistics circumstances under which it would be viable to implement reusable wine bottles. In order to do this, the relevant parameters from literature and practice had to be identified. A DST was developed, and the various identified parameters were implemented into the tool to evaluate the reusability of glass wine bottles. The DST was then tested on Distell as a case study to evaluate the reusability of one of their non-reusable glass wine bottle to answer the research question.

To place the methodology within the academic perspective, Mouton (2001:138) developed a structure that clarifies and describes the methods used to solve research problems. The ‘three worlds framework’, as the structure was known, illustrates how a real-life problem can be translated into a research problem. In the case of this study, the framework was used to illustrate how the methods are interrelated and to which research world it was applicable. Figure 2.1 provides an adapted illustration of the three worlds framework based on this research study.

Mouton (2001:138) describes World 1 as ‘everyday life’ where people use the knowledge that they have acquired through learning, experience and self-reflection to cope with everyday tasks. In the case of this research, the research question requiring the identification of the business logistics circumstances under which it is viable to implement reusable wine bottles, derives from World 1. The practical knowledge that should be taken into consideration to answer the research question also derives from World 1. Various sources of information include interviews with relevant managers, journal articles, company databases and company reports. A formal scientific approach should be taken to provide a methodical and systematic answer to the research question. At this stage, World 2 becomes relevant.

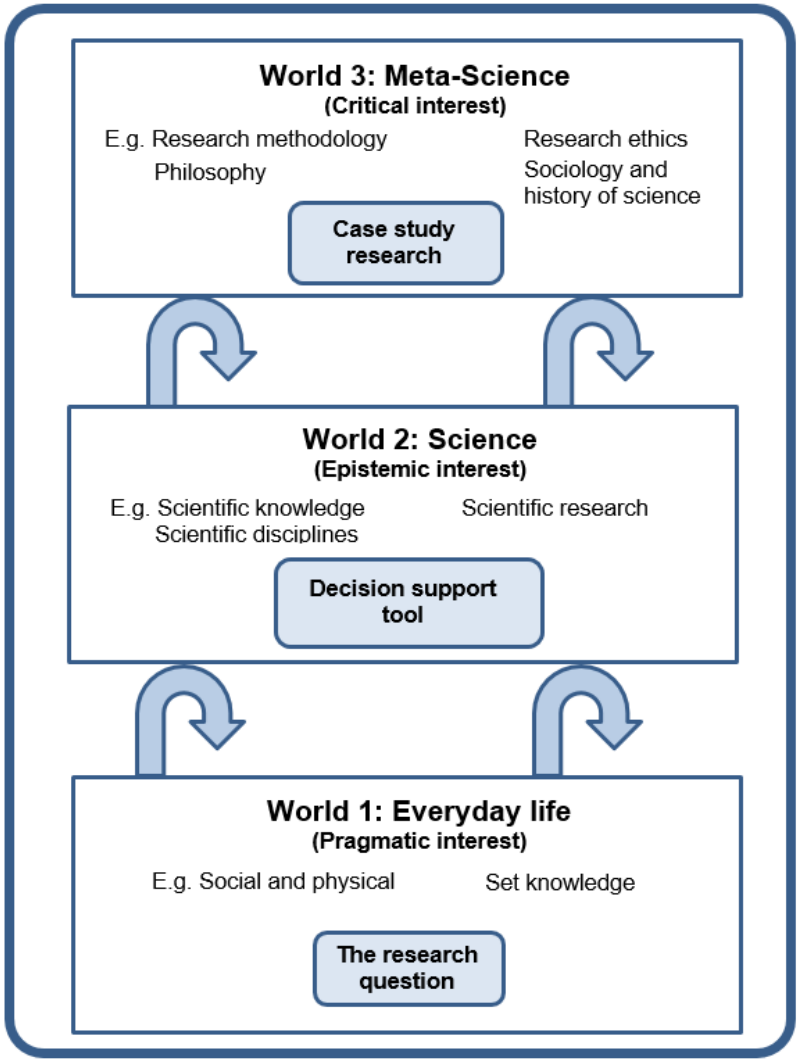


Figure 2.1: The three worlds framework (adapted from original image)
(Source: Mouton, 2001:139)

World 2 can be described as the world of 'science and scientific research' (Mouton, 2001:138). Mouton (2001:138) states that the aim of science is to generate valid and reliable descriptions, models and theories of the world. When this research study is taken into consideration, the use of a DST has been selected as the 'model' to assist the researcher to answer the main research question from World 1.

The DST is a model that supports choice by modelling outcomes and organising information (deriving from World 1) to assist decision makers (Sauter, 2011:13). The DST was used with the identified parameters to assist Distell's decision makers to identify the business logistics circumstances under which it would be viable to implement Distell's Brand X to be reused. The DST represents the World 2 scientific theory that is used to answer the main research question from World 1. To place World 1 and World 2 into the perspective of a larger scientific discipline, one should approach World 3.

In World 3, the scientific disciplines are referred to as 'meta-sciences' because it involves a reflection on the nature of science and scientific research (Mouton, 2001:139). Examples of

frameworks include research ethics, philosophy of science and research methodologies. A case study approach was selected as the main research methodology due to the exploratory nature of this study. Chapter 5 introduces and motivates the reasons for choosing Distell as the case company of this research paper.

Mouton's (2001:139) three worlds framework provides a perspective on how the research question can be answered by using a scientific research approach. The three worlds are interrelated and do not operate independently from one another. While the three worlds place the research design in perspective, a framework should be followed to ensure that the outcome of the research is valid and reliable. Figure 2.2 provides an illustration of the conceptual framework of this research. The conceptual framework divides the research into three sections within the context of designing and testing a DST to evaluate the reusability of glass wine bottles.

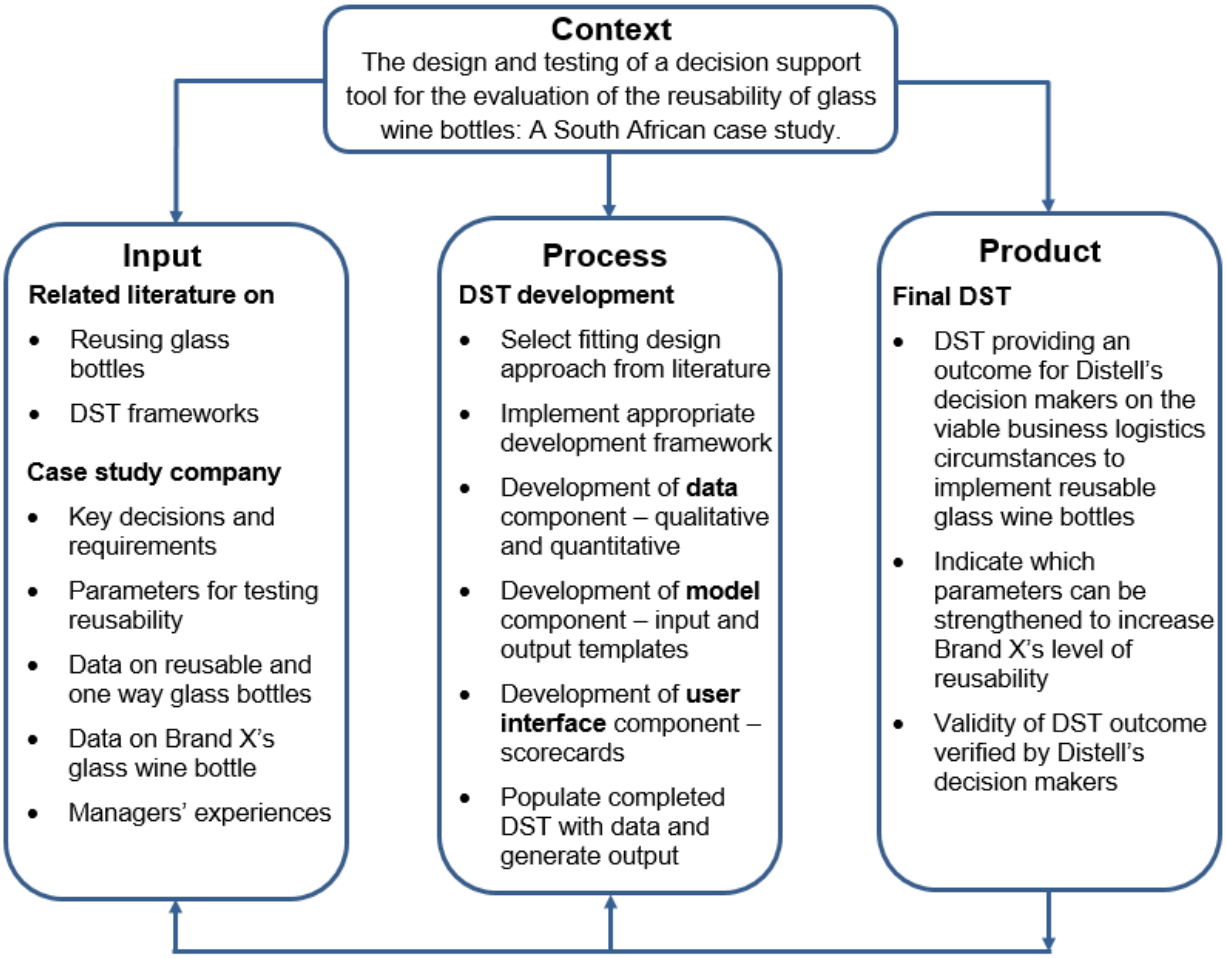


Figure 2.2: Conceptual framework of the research

The sections of the conceptual framework include an input, process and product section, which relates to the various chapters in this research. The input section of the conceptual framework highlights the literature that is required to understand the glass reusing industry and the literature on developing a DST. Information from the case company is also required to develop the DST according to their decision needs and requirements, managers' experiences, identifying

parameters that are relevant to evaluating the reusability of glass wine bottles, and acquiring qualitative and quantitative data. This is done in the literature reviews presented in Chapter 3 and Chapter 4, and the case study presented in Chapter 5.

The process section focuses on the design and development of the DST. The information guiding the development of a DST derives primarily from literature. The literature that proved to be relevant to this research was used for developing the DST. Important literature includes the design approach and the DST development frameworks. The development of the DST is discussed in Chapter 6 of this research before it was populated with the required data to generate an output.

Finally, the product section of the conceptual framework requires the completed DST to be able to provide a valid and reliable outcome for Distell's decision makers on viable business logistics circumstances under which they can implement Brand X as a reusable bottle. The overall validity of the tool was also verified by Distell's decision makers. The results of this stage are discussed in Chapter 7 of this paper.

A case study research design is used to answer the research question due to its exploratory nature. The research question of this study requires the researcher to identify the business logistics circumstances under which it is viable to implement reusable wine bottles. The parameters that were identified to answer the research question was done by studying the literature deriving from Chapter 3 and by working with Distell to gather more information on their logistical systems and reusable glass wine bottles. Chapter 5 discusses the motives for working with Distell in this research along with the DST's inputs concerning Distell's decision requirements and the qualitative and quantitative parameters.

The remainder of this research methodology chapter consists of:

- a research objectives section that explains the secondary objectives that should be achieved to answer the main research question;
- a research strategy section explains the overall research strategy, data collection techniques and the framework that is used to analyse the data; and
- a discussion of the measures that were taken to ensure the validity and reliability of the research.

2.2 Research objectives

The main research question of this study requires the researcher to identify the business logistics circumstances under which it is viable to implement reusable wine bottles. Five secondary objectives have been set out in the introductory chapter that will assist in answering the research question. The secondary objectives allow the research question to be broken down in smaller

manageable segments. Once these research objectives have been successfully executed, the main research question will be answered. The following five interrelated secondary objectives were set out for this research:

1. *Identify key decisions and requirements regarding the reuse of glass bottles*
   Companies reuse their glass packaging for various reasons, i.e. corporate citizenship, environmental sustainability, economic incentives, or as a result of government legislation (De Brito, 2004:49–51). Distell's key decisions and requirements for reusing glass wine bottles had to be identified to assist the researcher in developing the DST for this research. Information regarding the setting in which the case company operates also had to be examined on considering the decision needs for developing the final DST.

2. *Identify all qualitative and quantitative parameters from literature and practice for testing the reusability of glass wine bottles*
   Relevant parameters for measuring the reusability of a glass wine bottle were discussed and examined with Distell, along with the data that were required to formulate the parameters. Finding these parameters required research into topics such as literature on reusing systems, reusing practices and model development.

   After the relevant parameters for the DST were identified, and the information that was required to construct the qualitative and quantitative parameters was identified. The outcome of the DST is focused on measuring the reusability of glass wine bottles, therefore, parameters that relate to the recovering and reuse of glass wine bottles were considered. The qualitative and quantitative parameters that were identified from literature and interviews were verified with the case company to ensure the reliability of the DST.

3. *Evaluate the various decision support tool development frameworks to find the most suitable framework for this research*
   Several frameworks from various perspectives were identified throughout literature to develop DSTs. The three frameworks that are considered to be most relevant for this study are discussed in detail within Section 4.4 of the literature review. Each of the three frameworks has a different perspective on developing a DST and was used throughout the development phase of the tool.

4. *Develop a decision support tool for evaluating the reusability of glass wine bottles*
   The three frameworks discussed above were used to develop a complete DST for evaluating the reusability of glass wine bottles. The DST was built by following the development frameworks and using the identified and verified parameters. The tool is designed to be user-friendly, therefore the parameters are calculated by using Microsoft

Excel, which is familiar to many managers all over the world (Tennant & Friend, 2005:2). Microsoft Excel did all the calculations within the DST.

To make sense of the information deriving from Microsoft Excel, data visualisation software was used to serve as the user interface. In the case of this research, the user interface was primarily displayed by Tableau, even though other data visualisation software can also be used. Tableau is a data visualisation program that simplifies the visual interpretation of data presented by spreadsheet software such as Microsoft Excel. Tableau is not required for the DST, but it was used as part of the research to analyse and visualise some of the aspects.

5. *Test the DST at the hand of Distell's Brand X to determine the glass wine bottle's viability for reuse and make recommendations on whether to implement reusable bottles for Brand X based on the results deriving from the decision support tool*
   To ensure the validity of the DST's outcome, the DST was first tested on Distell's reusable wine bottles to reach a quantitative outcome based on the measured parameters. After the outcome proved to be reliable, Brand X's parameter information was entered into the tool. Brand X's outcome was compared to the outcome of Distell's reusable wine bottles to indicate how well the brand's parameters compared to wine bottles that are already being reused in the same industry.

   To increase the validity of the tool, the parameters of multiple non-reusable wine bottles that are similar in price range and volumes to Brand X were also tested within the tool. Doing this provided clarity on how Brand X compared within the spectrum of reusable and non-reusable wine bottles. The outcome of the tool was verified with Distell to ensure the reliability of the tool.

By executing the five secondary research objectives, the researcher laid the foundation for developing a reliable and valid DST for evaluating the reusability of glass wine bottles. The development of the DST was made possible by doing a case study with Distell.

2.3 Research strategy

The research strategy chosen for this study assisted the researcher in answering the main research question, i.e. identifying the business logistics circumstances under which it is viable to implement reusable wine bottles. The best approach for completing the main research objective was a case study approach with Distell due to the exploratory nature of this research. The case study approach falls into World 3 of Mouton's (2001:139) three worlds framework as discussed in the introduction of this chapter. Chapter 5 elaborates on the opportunity for conducting a case study with Distell as part of this research.

The use of a case study provides insight and information into a matter that has not been investigated before and which literature does not completely cover (Denscombe, 2007:55). Even though the literature covers some of the topics related to reusing glass bottles well, it lacks more information for the South African setting specifically. The case study approach is also used in this research as a platform to develop the DST and test the various parameters for evaluating the reusability of glass wine bottles.

Yin (2014:16) provides a definition of the scope of a case study to support it as the preferred research method. In his definition, he states: "A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (Yin, 2014:16). Yin motivates the use of a case study research in order to understand a real-world case. He assumes that such an understanding is likely to involve important contextual conditions that are pertinent to the case being explored.

Identifying the parameters that should be used in a DST for evaluating the reusability of glass wine bottles requires an in-depth and exploratory method of research since little information is publicly available on this topic (Taticchi, Garengo, Nudurupati & Tonelli, 2015:6477). By conducting a case study, theoretical frameworks from Mouton's (2001:138) second world were used for developing a DST that could be applied to a World 1 situation. Keeping the research within Yin's definition, the case study is done in contemporary circumstances (using current, recent data and information) in a real-life setting (using an existing company as the focus of the study) while focusing on organisational and managerial issues (deriving from company reports and interviews) (Myers, 2003).

The case study involved a single-case design. This means that the theory on developing a DST is tested based on a single-case study rather than multiple case studies. There are five rationales relating to a single-case study. The rationales include an *unusual, common, revelatory, longitudinal* or *critical* case. From the cases discussed above, the critical case rationale is considered the most relevant to this research.

The critical case rationale requires the theory (DST framework) to have a specific and clear set of circumstances within which its design is believed to be true (Yin, 2014:51). The single case can then be used to determine whether the designs are correct or whether a set of alternative explanations might be more relevant. Distell's position in the industry and their setting with existing infrastructure for recovering and reusing glass bottles represents the circumstances within which the design is tested, as is discussed in Chapter 5.

The research cannot be completed without collecting data. For this research, the data were collected from multiple sources in qualitative and quantitative format. This contributes to the methodical triangulation. Figure 2.3 illustrates an example of methodological triangulation. The

sources of data included documents, archival records, open-ended interviews, structured interviews and surveys, focus interviews and observations. Five of the six sources illustrated in Figure 2.3 were used within this research. The five sources include open-ended interviews, archival records, documents, surveys and observations.

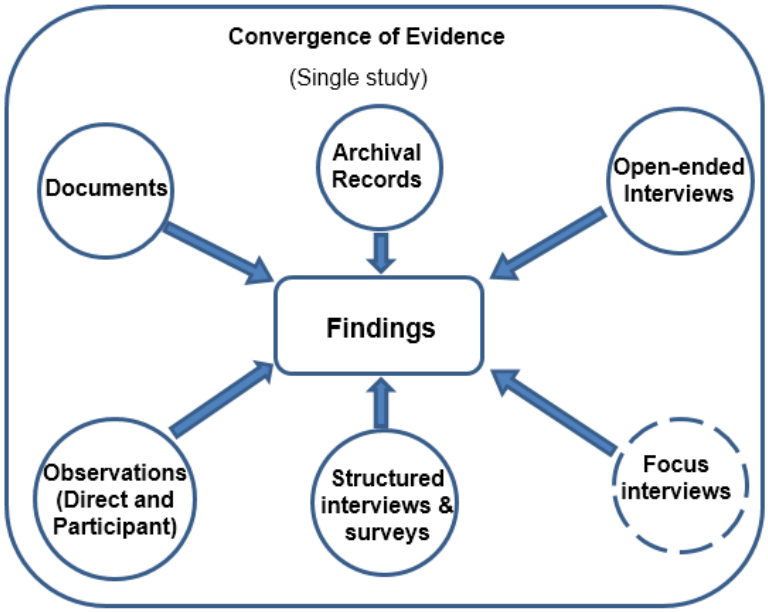


Figure 2.3: Convergence of multiple sources of evidence (adapted from original illustration)
(Source: Yin, 2014:121)

Open-ended interviews were used to gather more information on Distell's business setting, to learn about their reusing systems, to understand the glass bottle reusing market of South Africa and to identify parameters for evaluating the reusability of glass wine bottles. The archival records that were used were represented by statistics on the wine industry and also Distell's company reports to gain a better understanding of the environment in which Distell operates, as well as Distell's view on reusing glass bottles and how it fits into their long-term strategy.

An online survey was conducted to ensure that the parameters that were identified within the study are relevant and to gain the opinions of Distell's personnel on their importance. The observations were done at Distell's bottle sorting and washing plant in the Western Cape to better comprehend the reuse systems that Distell have in place. These systems had been discussed during previous open-ended interviews with Distell's managers. The documents that were studied were primarily journal articles that provided more information on reusing glass bottles in general and DSTs.

A disadvantage of methodological triangulation is that it adds complexity to research. However, using multiple sources within a single-case study increases the confidence that the research reflected the circumstances accurately and it enhances the internal validity of the research (Yin, 2014:122). The next two subsections elaborate on the data collection techniques and analysis frameworks used throughout the study. It is divided between primary and secondary research.

2.3.1 Primary research

The critical single-case study approach that has been selected for this research provides a rounded portrayal of the case company and assists the researcher throughout the development phase of the DST. Part of the primary research is in line with Phase 2 of the research methodology process discussed in the introduction, since it requires the collection of data from the case company. The primary data from the case company were collected from multiple sources in qualitative format, contributing to the methodological triangulation.

Not all the information that was required for this research is publicly available or available in company databases. Distell's and cross-industry companies' reusing practices are a case in point. Therefore, primary research was required for this study. The primary information was gained through personal interviews, observations, conversations, field notes and telephone interviews. The interviews were conducted with various managers within Distell as well as the broader wine, beer, soft drink and glass recycling industry of South Africa. The interviews served as an important method for acquiring primary information for the study.

Table A.1 in Appendix A contains a summary of the interviews that were conducted with various individuals and managers from the industries mentioned above. The interviews with managers provided insight into the large and complex reuse practices of Distell and other companies in South Africa that reuse glass bottles. The interviews also provided information on Distell's key decisions and requirements for the outcome of the DST. The managers who were interviewed were chosen based on their position in the company and the field in which they work. A combination of semi-structured and unstructured interviews was conducted to gain information from managers.

The unstructured interview approach proved appropriate for gaining information and literature on cross-industry reusing practices within South Africa, the views of managers on reusing glass wine bottles and the reuse process that Distell has in place. The interviews assisted the researcher to understand the industry and to identify relevant parameters for evaluating the reusability of glass wine bottles. The unstructured interviews were aimed at gaining an in-depth understanding of the research goals that were not yet fully understood or clear to the researcher (Zhang & Barbara, 2009: 225).

Even though the nature of the interviews was unstructured, a list of themes was established to guide the interviews to acquire more in-depth information. To keep a good record of interviews, notes were made and interviews were recorded where possible to ensure that the analysis of data is based on an accurate record (i.e. transcript) and to allow the interviewer to focus on the interview (Sauter, 2011:244). The interviews were summarised and the summary emailed to the

interviewee to validate whether the information gained from the interview had been correctly interpreted.

The most important information that derived from the interviews was more insight into the industry of reusing glass bottles and gaining clarity on the relevant parameters for evaluating the reusability of glass wine bottles. Insight was also gained into the needs of the case company that assisted in the development of the DST for this research. The DST is designed according to the company's key decisions and requirements. Their requirements highlight the quantitative and qualitative parameters that had to be considered for evaluating the reusability of glass wine bottles. The qualitative parameters are descriptive in nature, while the quantitative parameters are more complex and require the use of formulas.

2.3.2 Secondary research

The secondary research that was conducted is discussed by dividing it between qualitative and quantitative data. To keep the outcome of the research valid and reliable, the qualitative and quantitative information should uphold certain standards of quality. Sauter's (2011:73–82) characteristics of useful information was used to evaluate the information obtained throughout the study. It is discussed in Chapter 4. The secondary research subsection also discusses the data collection techniques, sources and the relevance of the information to the research.

2.3.2.1 Qualitative data

The secondary qualitative data that were required for this research had to include information on the reuse of glass bottles, DSTs and information on Distell's reusing initiatives and practices. The information on reusing glass bottles had to provide insight into: 1) the effect of reuse on sustainability; 2) the reuse of wine bottles; 3) international and local reusing practices; 4) reusing systems; and 5) drivers for reusing. This information can be largely found in Chapter 3 of this thesis. The information was obtained by reviewing books, articles, journals and previous studies on reusing glass bottles to cover all the relevant fields within the topic.

The topics covered in Chapter 3 were used to guide the researcher towards the development of the DST. Important practical considerations that affect the reuse process arising from the literature were used during the development phase of the DST. Even though not many parameters derive directly from Chapter 3, the literature provided the researcher with the required information to comprehend the setting in which glass wine bottles can be reused. This helped the researcher to approach the case company with more informed opinions on reusing glass bottles and identifying the relevant parameters.

The other important component of this research is the DST that is used to evaluate the reusability of glass bottles with the correct parameters. Literature on DSTs is discussed in Chapter 4 of this

research paper. It covers: 1) the components of a DST; 2) DST design approach; and 3) various frameworks for developing DSTs. The information was acquired from journal articles, textbooks and online articles that discuss DSTs.

The information from the literature review in Chapter 4 was used to inform the researcher of the various factors that are required for developing a DST. The various aspects of the DST that the literature in Chapter 4 covers assisted the researcher in understanding how the elements of the DST function and how they are interrelated. Understanding these elements of the DST helped to guide the researcher through the DST's development phase and to understand the type of information that the tool requires to function properly.

The secondary qualitative literature discussed above was cross-examined with the findings derived from primary sources as the study proceeded. The interviews that were conducted for the primary research helped the researcher to identify the literature that holds relevance to the South African environment.

The various sources of qualitative data played a vital role in triangulating information for the research. In order for the study to provide a valid and reliable outcome, the triangulation of information should be supported by quantitative data.

2.3.2.2 Quantitative data

The main research question of this study required the researcher to identify the business logistics circumstances under which it is viable to implement reusable wine bottles. It is important to acquire quantifiable information on the relevant parameters of Distell's reusable glass wine bottles to compare the outcomes of the parameters and to make a valid and reliable evaluation by comparing it to Brand X's parameters.

The relevant parameters were identified based on the qualitative information that was gathered from the primary and secondary research. The quantitative data constituted an important part of this research because the case company required a measurable outcome from the DST to evaluate the reusability of glass wine bottles. Secondary quantitative data from Distell's reusable glass wine bottles and on Brand X's glass wine bottle were used to formulate the parameters that have been identified. The parameters were broken down into manageable parts to indicate the specific data that were required. The parameters are discussed in Section 5.5.2. The specified data were then requested from Distell. Feedback from Distell indicated which data were available and could be collected during the period of the research.

Distell collected and prepared the data from their database while, in parallel, the researcher developed the DST. The initial results of the quantitative data collected from Distell were reviewed

early in the collection phase to ensure that it met the original specifications and that it was accurate, reasonable, of good quality and complied with the original expectations.

The specified data that were required from Distell were requested in a Microsoft Excel spreadsheet format via e-mail, since the model component of the DST is also in spreadsheet format. This allowed for the easy transfer of data from Distell's spreadsheet to populate the DST's spreadsheet. Tennant and Friend's (2005) development framework was followed to construct the spreadsheets for analysing the quantitative data. The spreadsheets were divided between multiple 'input' sheets and one 'output' sheet. The tool's input sheets contained the codes and formulas for calculating the identified parameters. The results from the parameters are displayed in the output sheet of the tool.

The outcome of the parameters from the output sheet was exported to the Tableau user-interface component. Tableau represents the tool's dashboard and is used to analyse and visually present the results from the parameters. Microsoft Excel was used as a secondary user-interface where the data can be viewed in its raw format. The outcome of the parameters from Distell's Brand X was compared to the outcome of Distell's reusable and non-reusable wine bottles. It primarily indicated how well Brand X's level of reusability performed in comparison to Distell's reusable wine bottles, while also indicating how well it performs when adding other non-reusable wine bottles to the tool.

To conclude, the outcome of the DST was presented to the decision makers of Distell so that they could determine its reliability. If it proved to be reliable, a decision could be made on whether Brand X can be reused from a business logistics perspective. The DST serves as one of various examinations the brand must undergo before a final decision can be made on whether it is viably reusable in practice. If the tool indicates that Brand X's glass wine bottle is reusable, further investigation will be required to test the viability of reusing the bottle from a more holistic approach. If not, further investigation on Brand X will not be recommended.

2.4 Validity and reliability

The validity and reliability of the methods that were used to arrive at a credible outcome is considered a vital aspect of this research. According to Saunders, Lewis and Thornhill (2009:156), reliability refers to the extent to which data collection techniques or analysis procedures will yield consistent findings, while validity is concerned with whether the findings reflect the true situation that has been studied.

A case study approach is a valid research technique that has been chosen as the research strategy to provide the context wherein the DST was developed and tested. To keep the data collection techniques and analysis procedures consistent, the DST was developed by following development frameworks from literature discussed in Chapter 4 of this study. At the end of the

research, the decision makers of Distell ensured that the DST had been correctly developed and the data correctly processed by validating the findings of the research.

A concern about the case study approach is that only one case company was used for the research. Using one company to develop a DST for evaluating the reusability of glass wine bottles limits the DST to only be used by one company. However, the case company provided a unique platform upon which to conduct this research. They already reuse several of their products, which provided a database to study, while they at the same time already have the required infrastructure for recovering and reusing glass wine bottles. This was considered as prerequisites for evaluating the reusability of glass wine bottles.

The majority of the interviews were fact-based as opposed to opinions, which leads to a reduction of possible bias. To counter the possibility of biases or poor memory recall on themes that were discussed, various managers in the glass reusing and recycling industry were interviewed to increase the methodological triangulation. A complete list of all the individuals that were interviewed can be found in Appendix A of this research study.

Finally, the quantitative data that were required to construct the parameters for the DST were evaluated based on Sauter's (2011:73–82) characteristics of useful information. This was done to ensure that the data were on the standard set out by Sauter (2011).

Chapter 3 – Investigation into the reuse of glass wine bottles

Containers such as glass bottles have been reused for thousands of years. Only as recently as the 1960s did companies start to use one-way glass containers due to the mass production of glass (Golding, 1998:14). Economies of scale from the mass production decreased the price of glass bottles to a point where reusing glass bottles commercially became more expensive than buying and discarding one-way bottles (Busch, 1987:70). Even though the reuse of containers is more expensive than disposing containers, there are still industries that reuse their glass bottles with success.

Chapter 3 contains a combination of literature and field work that was done to gain better insight into the reuse of glass bottles in South Africa. The topics that are covered by literature include reuse from an environment sustainability perspective, the logistics supporting the reuse of wine bottles, domestic and international reuse practices, existing reuse systems and drivers that motivate companies to reuse. The field work contributed to insight into domestic reusing practices. The information deriving from Chapter 3 helped to achieve the second research objective, which requires identification of all qualitative and quantitative parameters from literature and practice for testing the reusability of glass wine bottles.

3.1 Reusing and environmental sustainability

Reuse is becoming an increasingly relevant factor for modern day businesses due to pressure from governments and society compelling companies to do business in a more sustainable way. A ‘solid waste reduction hierarchy’ based on the work of Stock (1998) and Kopicki, Berg, Legg, Dasappa and Maggioni (1993) places the practice of reuse within the perspective of waste management. The hierarchy is illustrated in Figure 3.1.

The hierarchy is organised from the most (top) to the least (bottom) environmentally cautious method of handling waste. According to the hierarchy, the main goal is to reduce the use of resources. Resource reduction includes the minimisation of materials used as well as the minimisation of waste and energy used to produce the product. After this option has been depleted, the next aim would be to reuse materials, followed by the recycling of as much waste as possible, and disposal with energy recovery. Disposal in landfill is considered as the least environmentally cautious method of handling waste (Jayaraman *et al.*, 2008:141).

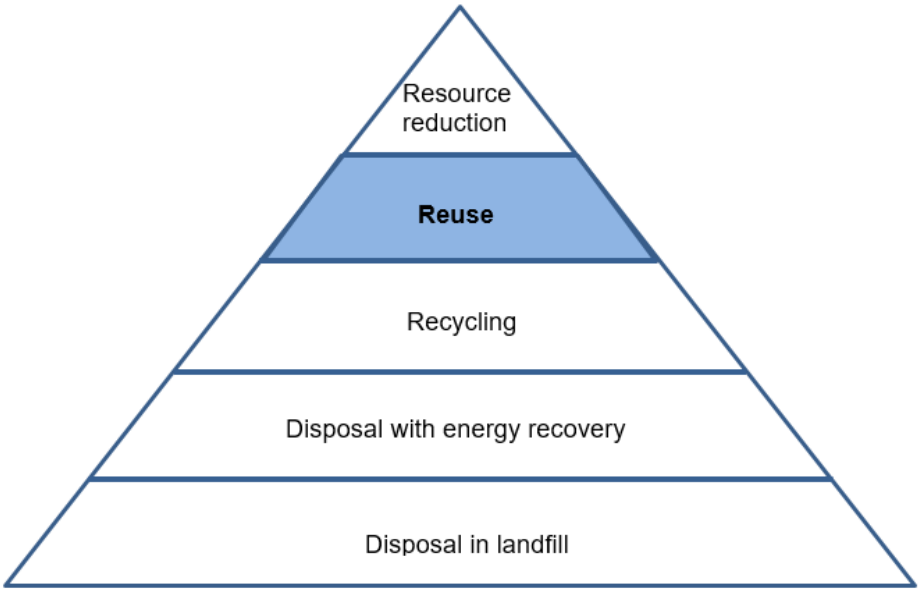


Figure 3.1: The solid waste reduction hierarchy
(Source: Stock, 1998; Jayaraman *et al.*, 2008)

All of the methods from resource reduction to disposal are interrelated. Within the scope of this research, the reuse of glass bottles results in a reduction of resources used because fewer glass bottles have to be produced. Recycling takes place when bottles that do not comply with the required quality tests are broken into cullets and melted into new bottles. This leads to a reduction of the required energy in comparison to producing new glass bottles (TGRC, 2013:9). Disposal with energy recovery is not applicable to this research study. Finally, reusing glass bottles leads to a decrease in glass disposal to landfills, which is the least environmentally cautious method of handling waste with regard to the solid waste reduction hierarchy.

Given the fact that reusing is the second preferred method on the solid waste reduction hierarchy, one still has to evaluate the effect it has on the environment. According to Incpen (2010), reusable bottles are less compact than one-way containers due to the bottles' increased thickness, leading to an increase in freight size and weight, which increases fuel consumption when transporting the bottles. Reusing containers also leads to an increase in the use of water and chemicals for washing, while land also has to be cleared to meet storage requirements at filling plants because of the additional inventory required to allow for peak demand periods (Incpen, 2010).

Despite the potential negative impact reuse can have on the environment based on the examples above, a study by Kroon and Vrijens (1995:57) found that returnable containers are still less of a burden to the environment than one-way packaging. This is true if each returnable container is reused at least a certain minimum number of times during its lifetime.

To conclude, reusing glass bottles has a less damaging effect on the environment as opposed to disposing or recycling glass bottles. To assure the sustainability of reusing glass bottles, companies have to manage the flow of materials to and from the end consumer effectively. The next section elaborates on the reuse of glass wine bottles from a business logistics perspective.

3.2 A business logistics perspective on reusing glass wine bottles

South African companies are currently more concerned with recycling glass wine bottles than reusing it on a commercial scale (Theron, 2013; WOSA, 2015). One reason for companies to recycle as opposed to reusing is the lack of redistribution systems (Golding, 1998:28). Van den Berg (2016a) states that the installation of a complete redistribution system requires a large investment, while maintaining such a system leads to high overhead costs.

Smaller wineries are not able to reuse their glass wine bottles on a commercial scale since they lack redistribution systems, which have high overhead costs within a price competitive industry. The result is that most glass wine bottles in South Africa end up being used as one-way containers. An opportunity still exists to reuse the one-way glass bottles due to glass's durable characteristics (Golding, 1998:28).

As stated above, there are large obstacles in the reusing process, such as a lack of redistribution systems and the enormous cost of collection and transportation (Haas, Murphy & Lancioni, 2003:61). Reverse distribution includes logistics activities such as network design, information flow, transportation, inventory, warehousing, material handling and packaging, all the way from products no longer required by the end user to products reusable in a market (Fleischmann, Bloemhof-Ruwaard, Dekker, Van der Laan, Van Nunen & Van Wassenhowe, 1997:7–8). Reverse distribution can take place through the (1) original forward channel, (2) through a separate reverse channel, or (3) through a combination of both (Ferguson & Browne, 2001:535).

Figure 3.2[1] places the forward distribution channel of wine from the point of origin to the point of consumption in perspective. The channel has various nodes from origin to the consumer that help to distribute the wine forward as indicated by the solid blue line. The red dashed line illustrates the orders that move in the opposite direction throughout the distribution chain in order to communicate the demand.

[1] Export distribution channel excluded from Figure 3.2.

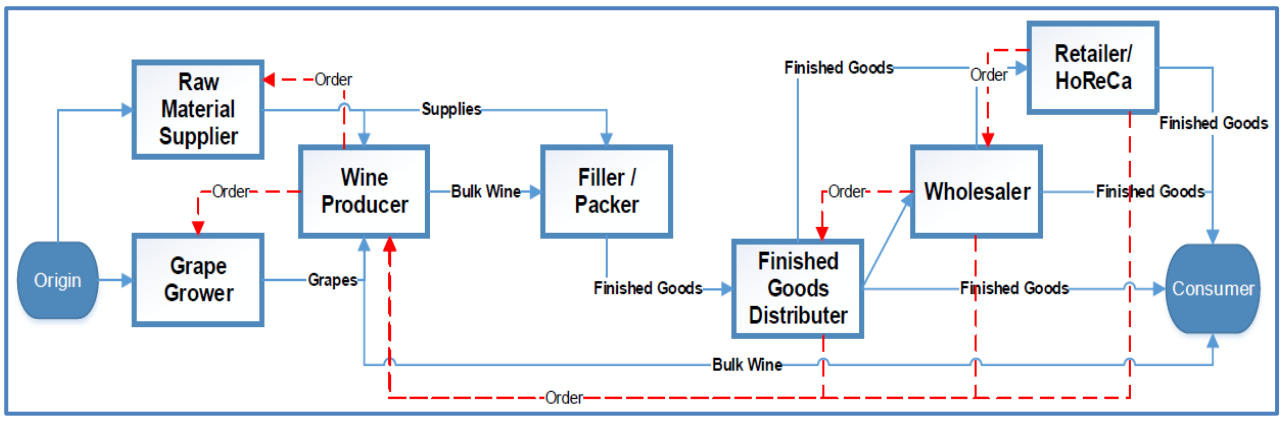


Figure 3.2: Wine supply chain for domestic market (Adapted from original illustration)
(Source: Garcia, Marchetta, Camargo, Morel & Forradellas, 2012:3)

To reuse wine bottles, the containers have to be redistributed from the end consumer to the node called 'Filler or Packer' for the bottles to be refilled and redistributed through the forward distribution channel. When the link is made between the 'end consumer' and the 'filler or packer', the resulting structure is referred to as a closed-loop supply chain (CLSC) as illustrated below in Figure 3.3 by the solid green lines (forward distribution of finished goods) and solid red lines (reverse distribution of empty glass bottles).

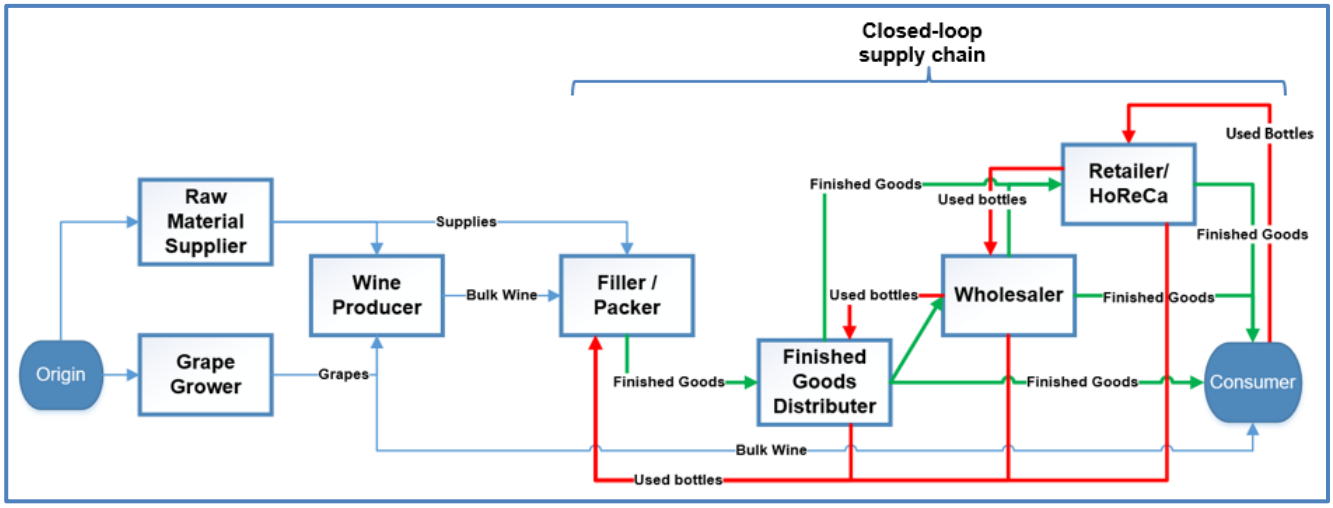


Figure 3.3: Wine supply chain for domestic market illustrating a CLSC (adapted from original illustration)
(Source: Garcia *et al.*, 2012:3)

Figure 3.3 is a simplified version of redistribution within the wine supply chain. When products such as glass bottles are redistributed, one should be aware of the various complications involved since a redistribution chain is not necessarily a symmetric picture of forward distribution (Fleischmann *et al.*, 1997).

From a systemic perspective, redistribution's complications come in the form of planning tasks. This includes backflow forecasting, selecting sufficient recovery options and remarketing issues that generally have no corresponding counterpart in traditional forward distribution channels (Nuss, Sahamie & Stindt, 2015:414). Uncertainties concerning the source, quality, quantity and

timing of the backflow of glass bottles add to the complications inherent to reverse distribution operations (Venkatesh, Punjabi, Gupta, Patil & Kadam, 2013:1; Nuss *et al.*, 2015:429).

The uncertainties, high cost and increased complications of reusing glass wine bottles lead to many companies simply avoiding the implementation of a reusing system. The consequence of not implementing a reusing system is wine being sold in one-way containers, which in effect has a negative effect on the environment if it is not correctly recycled or disposed of.

However, there are companies in international and local industries that reuse glass bottles on a commercial scale in an environmentally and financially feasible manner. Literature provides information on reusing practices as well as policies that governments put in place to encourage and incentivise the reusing of glass bottles. These are discussed in the following section.

3.3 Reusing practices

The policies and practices discussed in this section provide more information on how industries and governments work together to find ways to ensure that the reuse of glass bottles are practically viable on a commercial scale. This section elaborates on reuse practices from international and South African companies operating in the soft drink, beer and wine industry. The topics that are covered include policies and laws that various countries implement to encourage the reuse of glass containers and the practices that have been proven practically viable.

3.3.1 International reuse practices

The international reuse practices section examines Canadian provinces, European nations and developing nations. International literature on countries that reuse their glass bottles mainly derive from Canadian provinces and European nations (Platt & Rowe, 2002; Leighton, 2010). Government policies promoting the use of refillable containers are a large driving force for companies to reuse their glass bottles (Platt & Rowe, 2002:1). Some of the policies include eco-taxes on one-way containers to preserve and promote the reuse of containers (Platt & Rowe, 2002:4).

The eco-taxes create an economic incentive to package, sell and purchase beverages in refillable containers. A tax levy on one-way containers promotes environmental benefits of refilling without forcing companies to change their beverage packaging. Taxes imposed on one-way containers have survived many international trade disputes and have proven itself effective in Scandinavian countries and the Ontario beer market in Canada (Platt & Rowe, 2002:4).

3.3.1.1 Canadian provinces

Canada has a variety of policies in its different provinces that motivate beverage companies to use refillable containers. The legislation includes banning non-refillable containers for soft drinks and beer, quotas on the number of aluminium cans companies are allowed to produce and enforcing a deposit system (Platt & Rowe, 2002:22). The industry showed a mixed response with soft drinks companies opposing the ban on aluminium cans, which makes up a large portion of their products, while beer companies prefer refillable bottles since it is the cheapest packaging option.

The consumer plays a great role in the success or failure of a reusing system since they have to return the containers after use to keep the system functioning on a commercial scale. Fortunately, Canadian consumers do not regard the returning of bottles as an inconvenience and therefore Canadians are considered to have a good 'return culture'. The brewers from Quebec province state that they will continue refilling as long as the customers buy beer in refillable containers and return the empty bottles, which makes refilling the most economical way to package beer (Platt & Rowe, 2002:22).

An example where wine bottles are reused can be found in the Canadian province of British Colombia, where ten wineries have joined forces to implement a reusable wine bottle system. Together they have formed a third party that acts as a central purchasing agent for equipment and supplies. According to Leighton (2010), they are reusing and refilling their wine bottles with success due to the following factors:

- The local market accounts for a large percentage of the sales;
- There is a glass washing facility in the region, making the transport of bottles for washing economically feasible; and
- The province of British Columbia has a culture of returning containers since there is an established system in place to return bottles.

3.3.1.2 European nations

Most of Europe's success in reusing glass bottles derives from central and Northern European countries such as Sweden, Denmark, Germany, Netherlands, Finland and Norway. According to Platt and Rowe (2002:29), policies are the driving force behind the reuse of glass bottles in Europe, yet many of the reuse policies have been opposed by Europe's packaging industry.

The European packaging industry argues that laws favouring certain types of packaging restricts trade and distorts competition unnecessarily. The claims were taken seriously by the European Commission, who referred Germany and Denmark to the European Union (EU) court on charges that their beverage container laws violate trade agreements between EU member states (Platt &

Rowe, 2002:28). Although of interest, policy and law around packaging regulations are not included in the scope of this study.

Even though there are industries that oppose the use of refillable containers, the attitude of the beverage industry varies between countries and products (Platt & Rowe, 2002:28). One industry group that has proved to be truly in favour of reusable bottles is Europe's hotel, restaurant and catering (HoReCa) industry. The customers of the HoReCa industry prefer local and regional beverages in refillable bottles because of the cultural value they attach to eating and drinking in such places. Many breweries own restaurants and pubs, which makes reusable bottles the ideal packaging option for beer (Platt & Rowe, 2002:28).

Furthermore, Platt and Rowe (2002:28) state that Germany and Finland show great pride in their use of refilling systems, while Dutch soft drink bottlers prefer one-way containers and French bottlers expressed their resentment of Germany's beverage container laws. It proves difficult to find one policy that satisfies all EU member states because of the wide variety of views on returnable systems in the various countries. However, without reuse laws, one-way containers will dominate the European beverage market and even with the opposition to refilling, the European governments regard refilling as the best option for managing beverage containers (Platt & Rowe, 2002:28).

According to the study by Platt and Rowe (2002), policies seem to play an important role in Europe and Canada to encourage companies in the beer, soft drink and wine industry to reuse their containers. These policies mainly derive from their government's concern for the environment and for companies to do business in a sustainable way. Companies mainly oppose or accommodate these policies based on the effect it has on their financial state. Table 3.1 summarises the policies and the reusable containers as a portion of total sales for beer and soft drinks in various European countries and Canadian provinces.

Table 3.1: Refillable containers in the beer and soft drink industry of various first world countries and provinces as a portion of total sales along with the enforced policy

Province / Country	Soft drinks	Beer	Policy
Prince Edward Island (Canada)	100%	100%	Banned non-refillable containers
Ontario (Canada)	N/A	81%	Tax on one-way beer containers
Quebec (Canada)	N/A	80%	Quota: No more than 37,5% of beer may be in one-way containers
Finland	98%	73%	Levy on one-way containers
Denmark	90%	100%	Banned cans and require refillables for domestic soda or beer
The Netherlands	75-80%	100%	Packaging covenant: cannot substitute one-way containers for refillable containers unless environmental impact is the same or less
Germany	75%	75%	Quota: 72% or more of the beverages must be packed in refillable containers or be subjected to mandatory deposits

(Source: Platt & Rowe, 2002:2)

3.3.1.3 Developing nations

South Africa is considered a developing nation and is to a large extent comparable to other developing nations such as China, India and Brazil (Rong, 2012:4582). According to The Glass Recycling Company (2013:13), most developing nations do not reuse glass bottles based on a mandatory deposit system like most first world countries. These nations rather rely on a voluntary deposit system. Because of the fragmented supply chains within these countries, reusable glass bottles are able to compete against one-way alternatives. This is done via voluntary returnable schemes operated by business sectors, which makes it financially rewarding for lower income individuals (TGRC, 2013:13).

Companies that sell their products in reusable containers have made packaged beverages more affordable in Latin-American countries (Coca-Cola FEMSA, 2000:8). This is due to the reduced price paid after the bottles have been returned for a financial deposit.

Given this financial incentive, many low-income individuals in developing countries like Brazil make an informal living by collecting reusable and recyclable packaging that can be returned for a refund (Down to Earth, 2014). The next section focuses on reusing systems in South Africa to understand the practices and the drivers motivating companies to reuse their glass packaging.

3.3.2 South African reuse practices

South Africa has multiple companies within the soft drink and alcoholic beverage industry that are reusing their glass containers with success. Some of the companies include the Coca-Cola Company, Distell Ltd., South African Breweries and the Glass Recycling Company. However, South Africa has several challenges for the bottle reuse industry in the form of long haulage distances, few to no government legislation and policies on reuse, a 'throw-away culture' (Jhetam, 2016), and a monopolised glass manufacturing industry (Kotze, 2016; Smith, 2016). For South African companies to overcome these challenges, a sophisticated return system is required.

The Glass Recycling Company (TGRC), a voluntary South African initiative facilitating the recovery of glass waste, states that South Africa has one of the most sophisticated returnable bottle systems in the world (TGRC, 2013:13). South Africa uses three million tons of glass packaging annually, of which only one million is produced because of the combined returnable and recycling systems (TGRC, 2013:13). This means that around 67% of glass packaging that is used annually is prevented from entering landfills through recycling and the use of returnable bottles.

Sustainable business initiatives and financial incentives are two of the main reasons for South African companies to reuse their glass bottles as opposed to the strict government policies and regulations that are in place in Europe and Canada. South African Breweries (SAB) is South Africa's premier brewer and distributor of beer. They are well known in South Africa for reusing their containers with around half of their volume being sold in returnable bottles or kegs (SABMiller plc, 2015:22).

According to SAB, the concept of reusing glass containers is already being practiced in South Africa, since it is considered a cost-effective packaging option. Heyns (2013:13) states that the vast majority of beer in South Africa is sold in returnable glass containers. It is also estimated that 80% of beer is consumed in urban living areas where price is considered an important demand driver (Heyns, 2013:4).

The deposit on these bottles might seem low at around one to two Rands per bottle, but it is a large enough amount to serve as an incentive for the mass return of empty returnable bottles in rural areas (Smith, 2016). Smith (2016) states that the 750 ml quart glass bottle has an exceptionally high return rate of 97%, while some of the company's returnable bottles are doing an average of 30 trips in their life cycle. The sourcing of the empty bottles is done by SAB's own distribution network (Smith, 2016). The recovered glass bottles are inspected, sorted, cleaned and returned to inventory to be reused as new packaging.

Reusing the glass bottles multiple times offsets the cost of buying new inventory and makes the reusing system financially rewarding for the companies that implement it. A reusing system

should be accompanied by good management. Companies reusing their glass bottles generally find themselves within one of three reusing systems. In the next section, two of the three reusing systems that companies implement to reuse their glass bottles are discussed.

3.4 Reuse systems

Kroon and Vrijens (1995) and Golding (1998) are two of the main sources that cover literature on reuse systems. Pålsson (2016) and Kärkkäinen, Ala-Risku and Herold (2004:2) state that literature covering return systems with a focus on the recovery of returnable packaging is surprisingly limited.

The literature from Golding (1998) has a strong focus on pool systems and ways for companies from the same or different industries to cooperate to benefit from economies of scale. However, this research is more concerned with the management of reusable packaging within a system than with the size of the pool in which the system operates. Therefore, the systems from Kroon and Vrijens (1995) are discussed in more detail.

Kroon and Vrijens (1995) have identified three systems that accommodate the reuse of products such as glass bottles. They approach reuse systems from a reverse logistics management perspective. They focus on the different return system structures, which include: 1) switch pool systems; 2) systems with reverse logistics; and 3) systems without reverse logistics. For this research, only the switch pool systems and the systems with reverse logistics are relevant and explained in more detail.

3.4.1 Switch pool systems

In a switch pool system, there are three participants who each have an allocated number of containers for which they are responsible. The participants of the pool include a sender, receiver, and a carrier, or any combination of these three. Their responsibilities include cleaning, control, maintenance and storage of the containers (Kroon & Vrijens, 1995:58).

In the first variant of the switch pool, only the sender and receiver have an allotment of containers. A closed loop exists between the two participants in which the carrier delivers a load of full containers to the recipient from the sender in exchange for a load of empty containers to be returned to the sender from the receiver, as illustrated in Figure 3.4. When returned to the sender, the load is sorted, cleaned, maintained and stored to be refilled and sent back to the receiver (Kroon & Vrijens, 1995:58).

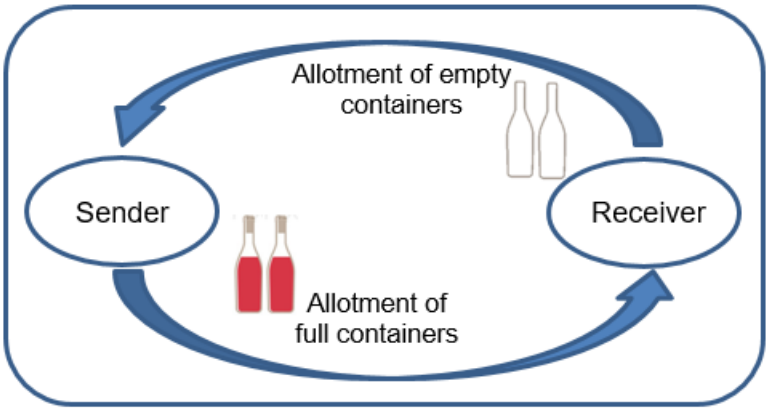


Figure 3.4: The first variant of the switch pool system. Illustration of participants and flow of containers

In the second variant, the carrier also has an allotment of containers. At each exchange of containers, a switch takes place. When the carrier picks up a load of full containers from the sender, the carrier drops off a corresponding number of empty containers. The sender does not carry the responsibility of administering the return flow of containers (Kroon & Vrijens, 1995:58). Figure 3.5 provides an illustration of the second variant of the switch pool system.

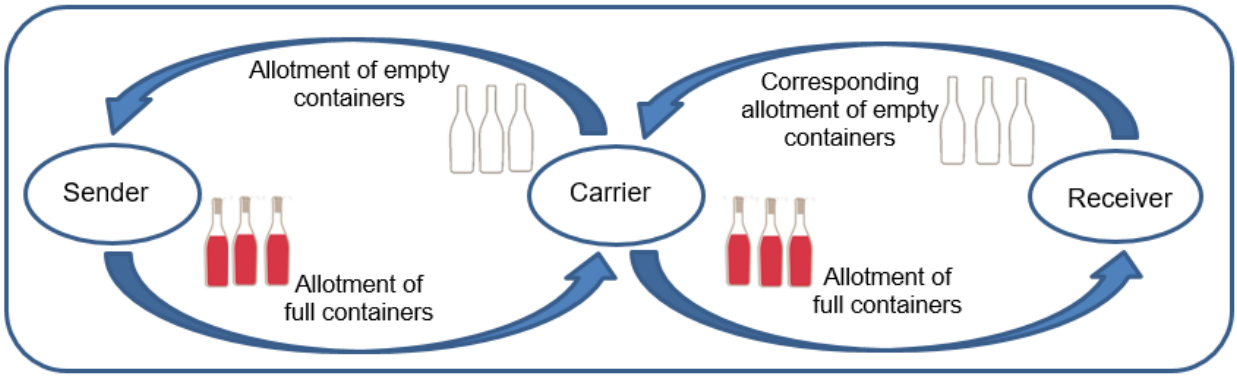


Figure 3.5: Second variant of the switch pool system. Illustration of participants and flow of containers

In practice, the switch pool reuse system is more suitable for smaller receiving participants such as hotels, restaurants and catering companies. The receivers have more control over the movement of the containers since the products are mainly consumed on their premises. The receivers are therefore more assured of returning their empty allotments to the carrier or sender in exchange for full allotments.

Once the participants in the supply chain become larger, such as multinational brewing companies (senders) and commercial retailers (receivers) where consumption of the products take place off the business' premises, another type of reusing system should be implemented to control the flow of containers. In such a case, the systems with reverse logistics are a better fit.

3.4.2 Systems with reverse logistics

In this system, the containers are owned by a central agency who can also be the sender in this case. The agency also bears the responsibility of ensuring that the containers are returned after the recipient has emptied it. The main prerequisite for this system is that the recipient bundles the empty containers together and stores it until a sufficient number of containers has accumulated so that the collection can be cost effective. Within this system, there are two subsystems i.e. a transfer system and a depot system (Kroon & Vrijens, 1995:59).

The transfer system is similar to the switch pool system's first variant since it only has the sender and receiver as participants as illustrated in Figure 3.6. However, the sender bears the main responsibility of the movement of the containers. The system is only concerned with the movement of empty containers from the receiver back to the sender. The sender is responsible for the tracking and tracing, administering, cleaning, maintenance and storage of the containers. The sender also has to take care that the number of containers are sufficient (Kroon & Vrijens, 1995:59).

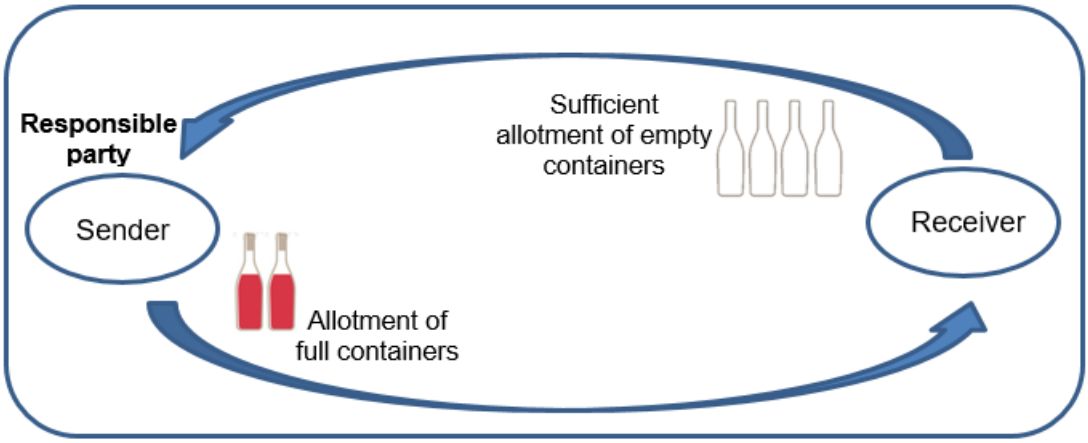


Figure 3.6: System with return logistics transfer system. Illustration of participants and flow of containers

In the deposit system, the containers that are not used are stored at container depots. The system starts at the container depot, which sends the requested number of empty containers to the sender as Figure 3.7 illustrates. The sender fills the empty containers and transfers the full containers to the recipient. After the bottles have been emptied by the recipient, the containers are then collected and transferred back to the container depot, which cleans and maintains it (Kroon & Vrijens, 1995:59).

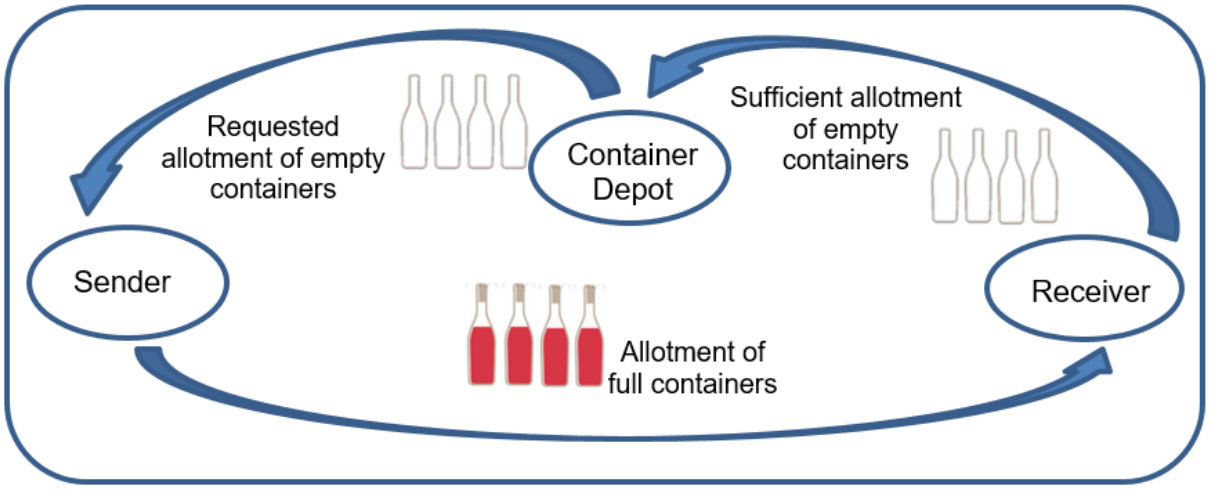


Figure 3.7: System with return logistics deposit system. Illustration of participants and flow of containers

Table 3.2 contains a summary of the two reverse logistics systems that are discussed above. The type of system a company implements depends on the type, weight, structure and quantities of the goods that are being used and on whether the sender already has a reverse logistics system in place. Other variables to consider, according to Kroon and Vrijens (1995:60), is the scope (international, national or regional) of the system, the cooperation of recipients, the willingness to invest from the sender and the receiver's standpoint, the available storage space, the control possibilities in the size of the organisation, and the acceptance in the market (Kroon & Vrijens, 1995:61).

Table 3.2: Reverse logistics systems adapted from original table

System	Essence	Partners	Responsibility	Possibilities
Switch pool	Every partner has an allotment	Sender, recipient	Every partner for own allotment	Direct switch
		Sender, carrier and recipient		Exchange-per-exchange switch
With reverse logistics	Reverse logistics by agency	Agency, sender, carrier, recipient	Agency	Transfer system
				Depot system

(Source: Kroon & Vrijens, 1995: 60)

3.5 Drivers for reuse

There are various reasons that motivate companies to reuse their packaging material. Four main drivers have been identified from literature. These drivers include: 1) economic drivers that focus on the profitability of reusing containers; 2) legislation that forces companies to reuse; 3) corporate citizenship where companies feel compelled to reuse (De Brito, 2004:48); and 4) environmental sustainability where companies reuse to reduce their ecological footprint.

3.5.1 Economic drivers

According to De Brito (2004:49), a company can gain economic value directly or indirectly by reusing their packaging materials. By recovering the used packaging materials, the company can add value to the goods to the extent that it can be reused as new packaging materials. This will give the reused glass bottles the same monetary value as a new glass bottle if it is properly inspected and cleaned. In return, this will give the company direct economic gains in the form of lower cost of inventory, reducing overall packaging cost, adding value with the recovery, as well better utilisation of resources and assets such as transportation efficiency (De Brito, 2004:49).

Companies reusing their packaging materials can also benefit from indirect economic gains in the form of an image-building operation (De Brito, 2004:50). A South African survey found that more than 50% of people are willing to pay a premium for products that are produced by companies that do business on a socially and environmentally sustainable way (Beverage Review, 2015:25). Creating awareness among consumers about a company's initiatives to reuse packaging materials can give a company a competitive advantage over rival companies using one-way packaging. The indirect gains come in the form of a green image, an increase in revenue from increased sales, as well as market protection from competitors (De Brito, 2004:50).

Having economies of scale when recovering packaging material is considered beneficial for companies that implement a reuse system. Retailers are generally the nodes in the supply chain accommodating the returned packaging. However, they might not always be in favour of reuse systems because it requires extra storage space and labour, which they must pay for. Platt and Rowe (2002:10) suggest that retailers can recover their costs by keeping a small number of the bottle's deposit to act as a handling fee. This will ensure that both of the mentioned parties benefit financially from a reusing system.

3.5.2 Legislation

Legislation in this case refers to compulsory laws forcing companies to recover their products. As discussed earlier in this chapter, some governments implement strict laws and policies that reward companies that comply with the legislation and penalise those that do not. The policies and laws come in the form of recycling quotas, packaging legislation and take-back responsibility for manufacturers (De Brito, 2004:51). De Brito (2004:51) states that the motivation behind the legal driver is to embrace consumer rights and pro-environmental legislation.

3.5.3 Corporate citizenship

Corporate citizenship arises when a firm feels socially impelled to act in a way that respects society out of good principles (De Brito, 2004:51). Corporate citizenship can also come in the form of social responsibility and ethics. When focusing on social responsibility within the context

of this research, one can argue that switching to returnable glass bottles as opposed to one-way bottles will cause people to lose jobs in the packaging manufacturing industry. Fortunately, Golding (1998:71) found that reusing packaging creates significantly more jobs than using one-way packaging. The jobs created by reusing can be found in the filling plants and redistribution chain of the reusing system (Golding, 1998:71).

3.5.4 Environmental sustainability

The effect of reusing packaging material on environmental sustainability has been discussed earlier in this chapter. However, it also serves as an important driver for companies considering reusing. When a company reuses packaging material, it preserves valuable natural resources. The resources generally include energy, water, minerals, land and fossil substances (Platt & Rowe, 2002:5). According to Platt and Rowe (2002:5), the impact that the discarding of packaging material has on the environment includes solid waste, emissions to water and emissions to air. Reusing packaging material limits the negative effects that one-way containers have on the environment and preserves scarce natural resources.

When a company develops a 'green' image, it can increase public relations and benefit the company by gaining market protection from having loyal environmentally concerned customers (De Brito, 2004:50). Companies that reuse their packaging material indicate to the authorities and public that they take responsibility for the waste of their business activities.

There are more drivers and motivations for companies to reuse their packaging material depending on a company's values and long-term strategic goals. The drivers discussed above serve as important considerations for companies to reuse their packaging material. However, the parameters that evaluate the reusability of glass wine bottles will have an important influence on the final decision on whether to reuse a glass bottle.

3.5.5 Summary

The reuse of glass bottles is not a new practice, neither internationally nor locally. When companies reuse glass bottles on a commercial scale, it creates additional jobs, improves the companies' financial state and contributes to environmentally sustainable business. However, the disadvantage of a failed reuse system can have a significant negative financial impact on the company that implemented it. Therefore, the tactical decision to reuse glass bottles should fall within a company's long-term strategy and managers have to be certain of their calculations.

Chapter 4 – Literature review: DSTs

Professor David Wilson (2015:1) says that "at the heart of strategy lies decision making". In modern day business where managers have access to more information than ever before, it can sometimes be overwhelming to take every considerable piece of information into account when a strategic decision should to be made. Fortunately, decision-making can be effectively supported by computer-based information systems associated with the management, operations and planning levels of an organisation.

These systems are called decision support systems (DSSs) or DSTs (Taticchi *et al.*, 2015:6476). They are considered useful when it is not obvious what information has to be provided, what models should be used, or what criteria are most appropriate to make a strategic decision (Sauter, 2011:18). This chapter is focused on the various frameworks, processes and data requirements for developing a DST. This assists in executing the third research objective that requires the evaluation of the various DST development frameworks for this research study.

Various researchers have written about DSTs and their implementation in practice (Linton & Johnston, 2000; Ferguson & Browne, 2001; Power, Sharda & Burstein, 2002; Shim, Warkentin, Courtney & Power, 2002; Tennant & Friend, 2005; Sauter, 2011; Taticchi *et al.*, 2015; Wilson, 2015). Power (2002) defines a DST as *"*an interactive computer-based system or subsystem intended to help decision makers use communications technologies, data, documents, knowledge and/or models to identify and solve problems, complete decision process tasks and make decisions*".*

Sauter (2011:13) provides another definition of a DST similar to Power's by defining it as "a computer-based system that supports choice by assisting the decision maker in the organisation of information and modelling of outcomes". DSTs provide business intelligence and analytics in a form that supports and improves management decision processes (Sauter, 2011:xiii).

An effective and efficient supply chain management system is important for reusing containers. Developing a DST with regard to supply chain management can be defined as the management of supply chain operations, resources, information, and funds to maximise the supply chain profitability, while at the same time minimising the environmental impact and maximising the social well-being (Taticchi *et al.*, 2015:6474). Taticchi *et al.'s* (2015) definition emphasises that effective and efficient management of a company's supply chain can be economically, socially and environmentally beneficial, especially for reuse.

Reusing a one-way glass wine bottle can be related to the benefits that Taticchi states above. Much information from various perspectives on the one-way bottle should be considered before

such a strategic decision can be made. As previously stated, a DST can assist managers with such complex strategic decisions.

Taticchi (2015:6474) also states that environmental benefits can be associated with the development of a DST and an effective supply chain. The decision to reuse glass wine bottles can be associated with a positive effect on the environment if it is implemented correctly, as discussed in Chapter 3. Governments and societies are increasingly encouraging companies to operate on a more sustainable basis.

Even though sustainable business is an important matter, Kroon and Vrijens (1995: 67) have found that companies would rather consider the economic and logistic implication before the environmental implications of reuse is considered. Linton and Johnston (2000:17) state that there is a case in their studies where using a DST has improved the profitability of a company's remanufacturing operation, supporting the fact that it can be financially rewarding for a company to implement a DST. However, for a DST to be able to assist managers in making decisions that improve a company's profitability, much information is required.

Thierry (1995:116) states that the acquisition of data required to make accurate reuse decisions is problematic. The data that are required to support reusing activities are scattered throughout a company and down the supply chain. In an article by Gooley (1998), he says that "a successful reverse logistics program depends heavily on gathering meaningful information that can help manage the returns process while tracking costs". Measuring a glass wine bottle's level of reusability will also depend on meaningful information, especially measurable information, in order to link strategy to operation.

Gathering large amounts of data that are scattered throughout a company and down the supply chain to make strategic decisions, is considered a complex problem to solve. Complex problems often require techniques to break them down into manageable steps and to overcome any inherent biases and errors. Two different approaches to decision-making have been identified by Taticchi *et al.* (2015:6477):

- Structured decision-making involves defining a complex problem with stakeholder input and breaking that into decision objectives. It then involves picking and evaluating different alternatives. Finally, trade-offs are made for picking the preferred alternative.
- Multi-criteria decision analysis involves establishing multiple decision criteria. It then involves assessing the criteria against each of the alternatives. Finally, a weighting is obtained, which is fed into the software that calculates an overall score for each alternative.

The objective of the approaches above is to have strategic decisions being made based on a holistic view considering multiple stakeholders, goal relationships and related performance

measures rather than optimising one or a few dimensions (Taticchi *et al.*, 2015:6477). As previously stated, DSTs are computer-based systems that support managers in making these strategic decisions. The next section focuses on components that make up a DST.

4.1 DST components

A DST consists of three major components, i.e. data, a model and a user interface, as illustrated in Figure 4.1 (Sauter, 2011:15). The data component includes access to internal and external data, relevant information and knowledge. This data are used in the model component of the DST where modelling functions and calculations are executed. The user interface represents all the mechanisms where information is inserted into the system and an output is acquired from the system. This includes input screens where users request data and models, and output screens where users obtain the results (Sauter, 2011:16).

The user interface component manages the connection between the users and the rest of the system. A good DST should have a balance among the three capabilities mentioned above. The DST should also be user-friendly to allow non-technical decision makers to interact in full with the system. It should allow access to a wide variety of data and provide analysis and modelling in various ways (Sprague & Watson, 1996).

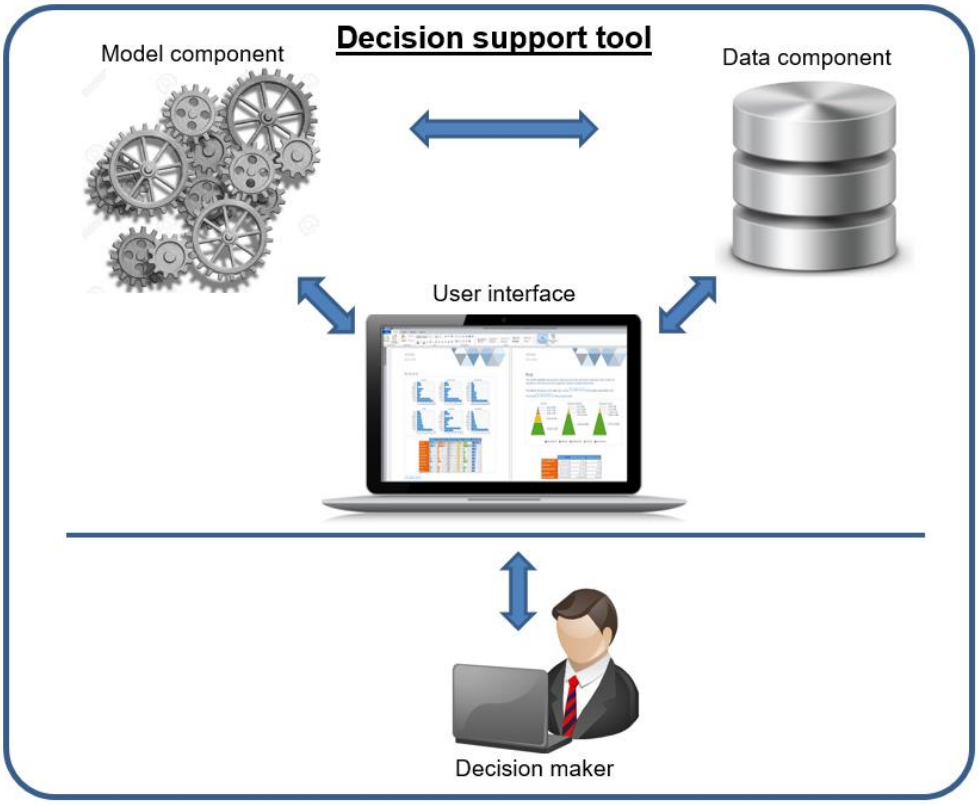


Figure 4.1: Components of a DST
(Source: Sauter, 2011:15)

The major components discussed in this section are present in any form of DST. Understanding how the components are linked with one another is as important as understanding which

framework will be best suited for the DST being designed. Before a framework is chosen for designing a DST, one should know which approach would be best suited to achieve the desired outcome for the DST that will be developed. The next section elaborates on the DST design approaches.

4.2 DST design approach

When designing a DST, one should follow a set of guidelines to assure the success of the outcome. A DST requires a unique approach to design. The approach must include a process and a product relating to the constraints of the field in which the DST will be used. Sauter's (2011:329) two methods suggest that either the system will be built from nothing ("one-stage, complete system") or current technologies should be used to facilitate the development ("quick-hit method" and "evolutionary method").

The approach depends on what the designer wants to achieve with the DST. If the designer wants to have a DST with a one-time development and some maintenance over time, Sauter (2011) suggests taking the "one stage, complete system" or the "quick-hit method" approach. If the designer wants the system to grow with the demands placed on it, the "evolutionary development" will be the suggested method.

The "one-stage, complete system" approach assumes that nothing is available on which to build the desired DST. This means that there are no models, databases, database management system or user interfaces. It requires the designer to build and code every aspect of an entire system and deliver it completed to the decision maker. Early DSTs were built with this approach due to the lack of existing software programmes such as Microsoft Excel. It is unusual to use this approach to DST design today, except if the problem is very specific or if a unique system is required (Sauter, 2011:331).

The "quick-hit method" and "evolutionary method" are the approaches that are generally used to design a DST today. Large advances in technology has enabled more types of data to be used, shared and integrated between a greater number of applications, making better decisions possible. Increasing numbers of models are computerised and easily integrated within a DST. It is considered inefficient to design without them (Sauter, 2011:331).

If centralised tools are implemented properly for designing a DST, it can result in the development of a very efficient engine and a system that integrates well with other systems. When the correct design approach has been identified, the designer can confidently decide on the correct framework to develop the desired DST. The following section elaborates more on the various frameworks that exist for designing a DST.

4.3 DST frameworks

When trying to understand a new or complex subject, the use of frameworks, typologies or conceptual models are often crucial in assisting developers to organise and categorise information (Sprague & Watson, 1996). A good set of categories should indicate parts of a topic and how they are interrelated (Power, 2002:12). Power (2002:12) identifies seven different sets of frameworks that categorise the large number of computerised systems that support decision making. They include:

1. Communication-driven DST
2. Data-driven DST
3. Document-driven DST
4. Knowledge-driven DST
5. Model-driven DST
6. Web-based DST
7. Spreadsheet-based DST

The term 'driven,' which is used for the first five DSTs, refers to the tool or component that is providing the dominant functionality within the DST. The last two DSTs are 'based' on the platform from which DST's are run. There are more categories, but according to Power (2002:12), these are the most common DST frameworks that are currently in use. From the seven DST frameworks, three interrelated frameworks have been identified as relevant to this study. The data-driven, knowledge-driven and spreadsheet-based decision support tool frameworks were used to develop the final DST for this research.

- **Data-driven DST**

  The data-driven DST provides access to and manipulation of large databases of structured data and a time-series of internal company and external data. Additional utility is provided by data warehouse systems, allowing the manipulation of data by computerised tools adjusted to a specific task and setting (Power, 2002:13). The data-driven DST framework provides the platform for developing the DST to accommodate the data component of this research.

- **Knowledge-driven DST**

  Knowledge-driven DSTs use artificial intelligence and statistical inference technologies to suggest or recommend actions to managers. A knowledge-driven DST provides specialised problem-solving expertise stored as facts, rules, procedures or in similar structures (Power *et al.*, 2002:2). This expertise consists of knowledge within a particular field, the understanding of the problems within that field and skill at solving some of those problems. For this research,

these facts, rules and procedures derive in a qualitative form from literature and interviews with managers working for Distell.

Power (2002:13) also emphasises the importance of sifting through large amounts of data in order to create data content relationships and searching for hidden patterns in a database. The experience and practical knowledge of Distell's managers can assist in the identification of relationships and patterns emerging from the data.

- **Spreadsheet-based DST**

  Most managers are familiar with spreadsheet packages such as Microsoft Excel. A spreadsheet-based DST is used when a DST will be implemented using a spreadsheet package. Spreadsheet packages are considered to be DST generators since it fits into Sprague and Carlson's (1982:11) definition of a DST generator. It is defined as "a computer software package that provides tools and capabilities that help a developer quickly and easily build a specific decision support system". Spreadsheets qualify as DST generators because 1) they have sophisticated data handling and graphic capabilities; 2) they can be used for "what if" analysis; and 3) spreadsheet software can facilitate the building of a DST (Power, 2011).

  The spreadsheet-based DST framework represents the model component in this research that accommodates the data component of the DST. Microsoft Excel spreadsheets provide pivot tables and charts that can be developed to assist decision makers in summarising and manipulating the data (Power, 2011). The spreadsheet-based framework was used to manipulate and summarise the quantitative data deriving from the identified parameters.

To conclude, with the seven frameworks to choose from, one has to select the right tool for the decision support task that is being considered. For this research, a combination of the data-driven, knowledge-driven and spreadsheet-based framework was used to develop the DST. The next step is to follow a set plan consisting of various design stages. Sauter (2011) sets out two interrelated frameworks, while Tennant and Friend (2005) sets out a process for designing a DST that is discussed in the following section.

4.4 DST design and development stages

Once the researcher has decided on the combination of frameworks that suits the desired outcome of the DST, a methodology containing all the required steps has to be followed for developing the final DST. Sauter (2011) proposes two interrelated design frameworks from slightly different perspectives, while Tennant and Friend (2005:32) have a process map which designers can follow to build a business model such as a DST.

Sauter's first framework consists of four design stages, while the second framework focuses on the seven lifecycle stages of the DST development framework (Sauter, 2011:321). Tennant and Friend's (2005) process map is built around the development of a business model that makes use of quantitative data and Microsoft Excel spreadsheets.

During the development of the DST, the researcher must bear in mind that the DST must make it easier to obtain data, improve knowledge management and improve the outcomes for it to be used (Sauter, 2011:316). The frameworks and process above guided the researcher through the complete development of the DST for this research study.

4.4.1 Sauter's development frameworks

Sauter's (2011) first framework consists of four design stages with their objectives and concerns. These are shown in Table 4.1. In the first stage, the designer is required to focus on the decision needs and environment. The stages following the first stage require the designer to examine the parameters required to achieve the desired outcome of the DST. It is important that the designer of the DST finish one stage completely before moving on to the next.

Table 4.1: DST design methodology

Stages	Objectives
Initial analysis	• Identify key decisions • Identify key information needs (focus on industry-based needs, corporation-based needs, and decision-specific parameters.)
Situation analysis	• Understand the organisational setting • Understand the task at hand • Understand the user characteristics
System design	• Logical design • System construction • System evaluation
Implementation	• Demonstration • Training • Deployment

(Source: Sauter, 2011:321)

While the four design stages listed above are being executed, the designer must bear in mind in which stage of the development lifecycle the DST finds itself. The list below is a second set of stages that are interrelated with the first four stages above and must be executed one stage at a time. The second set elaborates on the four design stages in the table above and it has a stronger focus on the context in wherein the designed DST will be based. Sauter's (2011:316-317) development lifecycle methodology emphasises the following stages:

1. **Identify requirement specifications based on contextual issues**

   The first stage requires the system to be designed from the end user's requirements. The designer must identify the needs for data integration in order to bring improvement in the decision-making process.

2. **Preliminary conceptual design**

   There must be an emphasis on inputs and outputs from the end-user requirements: what do they need and how must it be represented? Also, in this step, the designer identifies specific hardware and software requirements and identify specifications for databases.

3. **Logical design and architectural specifications**

   This stage requires the designer to specify the user interfaces. Using prototypes, the designer can test the user friendliness of the system and adjust it as the end-user requires it.

4. **Detailed design and testing**

   It is important to test the system during the development process with the end user. Tests should also be done on the flexibility, reliability and scalability of the system and its performance under specific failure scenarios.

5. **Operational implementation**

   This stage requires the tool to be made operational in a subset of the decision maker's environment. The system will be linked to the appropriate parts of the data warehouse and are then made available to the decision makers.

6. **Evaluation and modification**

   The system will be evaluated in terms of overall user acceptance, system integration, architecture flexibility and scalability. Finally, the system is modified across the organisation.

7. **Operational deployment**

   Final changes to the system are made and then it is distributed to all users after the users have been trained to use it. This stage requires continuous monitoring of the problems in the operation of the system and the patterns of use that might suggest problems.

Sauter's life cycle and design stages for developing a DST serve as an important guide to the development of this DST. It indicates the stage of development the DST is in and it serves as a guide for the stages that still have to be finished to build a reliable DST. Tennant and Friend's (2005) development process focuses more on the physical building of the tool.

4.4.2 Tennant and Friend's development process

Tennant and Friend (2005:32) created their own process for developing a business model. The process map is illustrated in Figure 4.2.

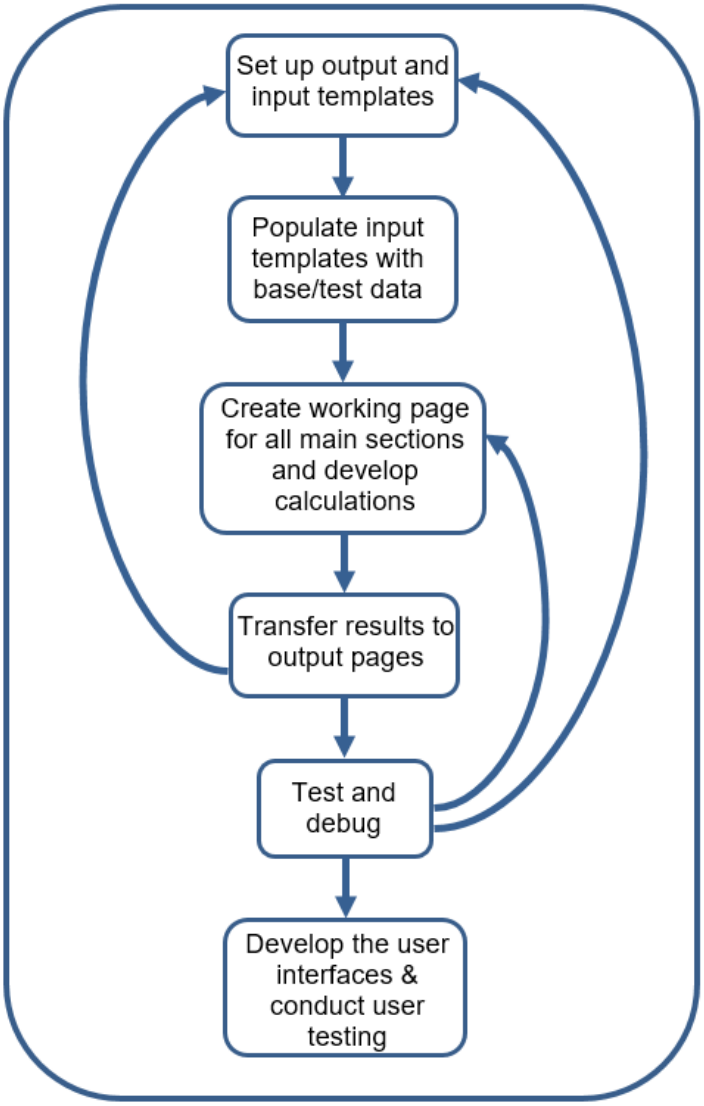


Figure 4.2: Business modelling process
(Source: Tennant & Friend, 2005:32)

The map consists of the following seven interrelated development processes (Tennant & Friend, 2005:33-34). As previously stated, the modelling process is based on building a business model using Microsoft Excel spreadsheets.

1. **Set up input and output templates**

   The first stage of developing the tool requires the designer to set up spreadsheets containing templates for all inputs and outputs at the beginning of the process. The functioning and accuracy of the DST can be tested throughout the development of the entire tool.

2. **Populate input templates with base or test data**

   To allow the model development to continue, the second stage requires the templates that were developed in the previous stage to be populated with data. This helps the designer to estimate the effectiveness and accuracy of the work done on the tool. It is

recommended that real data be used. However, in the absence of real data, 'test' data reflecting likely trends of the actual data can be used.

3. **Create working pages for all main sections and develop calculations**

   In this stage, separate sheets should be created for the various main categories of calculations that will be required. The categories of this research will be represented by the identified parameters. When the sheets and their outline structure have been established, the formulas and codes can be developed. The designer should avoid modelling to a level with unnecessarily high levels of data.

4. **Transfer results to output sheets**

   Transferring the results to the output sheets as the tool is being developed allows the designer to identify any issues early on. This will highlight any potential modelling problems that were not foreseen during the planning phase. The designer can then take remedial actions as soon as possible.

5. **Test and debug**

   Once all the calculations have been made and the results transferred to the output sheets, the designer should test and debug the tool. This stage is designed to ensure the technical accuracy and logic of the tool.

6. **Develop the user interfaces and conduct user testing**

   The user interface should be developed to the specifics on who the final user will be. The user interface may include navigation and printing tools, online help and user input error-reporting messages for example. When the tool is complete, it should be tested by a group of users who should also provide feedback and the tool should be adjusted accordingly.

The development process from Tennant and Friend (2005) is followed in Chapter 6 of this research study due to its practical and structural approach. It serves as the framework for analysing the quantitative data deriving from the case company. The data that are required for this research have to be useful to provide a reliable and valid outcome from the DST. Sauter (2011) elaborates on the characteristics that relates to useful information.

4.4.3 Sauter's characteristics of useful information

To keep the data that are collected throughout the research for using a DST to the standard set by Sauter (2011:73), twelve characteristics of useful information were identified. They are explained in Table 4.2. These characteristics were considered throughout the data collection phase of this research and were verified against Table 4.2 after it has been collected.

Table 4.2: Characteristics of useful information with definition

Data characteristic	Explanation
Timeliness	The information must be available to the decision maker while it is still meaningful
Sufficiency	The data must be adequate to support the decision under consideration (i.e. Is the sample large enough? Is the time horizon long enough?)
Level of detail	A lower level of detail within a well-defined scope is recommended. This will allow the decision maker to collect the data in ways that are more meaningful
Understandability	Simplifying the presentation of data within the database without losing the meaning of the data
Freedom from bias	Biases can be caused by factors such as non-representativeness with regard to time horizon, variables, comparability / sampling procedures
Decision relevance	One should always consider whether the information to the choices under consideration are relevant
Comparability	Measurement conditions must be held constant
Reliability	Data must be accurate, correct and verified
Redundancy	The user's ability to link data from multiple sources should not be limited
Cost efficiency	The benefit of improved decision-making capabilities must outweigh the cost of providing it
Quantifiability	This does not assume that all measures are quantified, but rather that the level of quantification dictates the types of meaningful mathematical operations that can be performed with the data
Appropriateness of format	This refers to the medium for data presentation, ordering in which data are presented to the decision maker and the extent of the graphics used

(Source: Sauter, 2011:73–82)

4.5 Summary

The development of the DST for this research greatly depended on the design approach, DST frameworks and the various DST design and development stages in order to successfully design and test the decision support tool for evaluating the reusability of glass wine bottles. In order to ensure that the DST complies with the theories relating to its development, the DST was evaluated with the development framework and development process from Sauter (2011) and Tennant and Friend (2005). This evaluation is presented at the conclusion of Chapter 6. To ensure that the data are useful as explained above by Sauter (2011), the data that were obtained from the case company are evaluated at the end of Chapter 7.

The next chapter elaborates on the case company that participated in this research study. The chapter includes the background of the case company, their experience with reusing glass bottles, the motivation for focusing on Brand X to be considered for reusing and the opportunity that existed for conducting this research with them.

Chapter 5 – Case study: Distell Ltd.

Due to the exploratory nature of this research, a case study approach was selected as the preferred method to answer the primary research question. This chapter provides a short overview of Distell, including their experience with reusing glass bottles. *Brand X* and the motive for focusing the research on the brand is also explained, along with the opportunity that existed for conducting case study research with Distell. The last section of this chapter provides information that was contributed to this research by Distell and the company's key personnel.

5.1 Company overview

Distell was selected as the case company for this research to help the researcher conduct a situation analysis as Sauter's (2011:321) DST development framework requires. Distell is a South African based company that produces and markets spirits, ciders, RTDs and wine domestically and internationally. The company was created after the merging of Distillers Corporation Ltd. and Stellenbosch Farmers Winery Group Ltd. in 2001. Distell has shown great leaps of growth since it has merged and has been listed on the Johannesburg Stock Exchange in South Africa. Their annual turnover was R21,5 billion in the year 2015 with market capitalisation of R35,937 Billion (Distell Group Ltd., 2016a).

The company has a large presence in the South African alcoholic beverage market and is currently the second largest producer of ciders in the world, while having a 96% share of the total market volume in South Africa in 2015 (Euromonitor International, 2016). Distell also has a well-recognised presence in the spirits market of South Africa with strong renowned brands. However, they are not as dominant in the spirits market as in the cider market. Regarding Distell's position in the wine market of South Africa, they had a 33% total volume share in 2015, which increased to 36% in 2016 (Euromonitor International, 2016; User, 2017). This is the largest share in the South African wine market held by a single company (Euromonitor International, 2015).

Distell uses their position of having strong economies of scale, well-established distribution networks and trusted brand names to recover and reuse some of their brands' glass bottles. Because Distell also reuses some of their glass wine bottles on commercial scale, it provided a unique opportunity to conduct the case study with them to identify the parameters that should be used in a DST to evaluate the reusability of glass wine bottles.

5.2 Experience with reuse

Sustainable business has become an important matter in modern society due to pressure from stakeholders and government. Distell has made large contributions to sustainable business and reusing some of their products' glass bottles is one of these initiatives. Around 2009, Distell

introduced the ‘Give Back, Get Back’ (GBGB) initiative that is focused on creating awareness among people about the advantages of returning empty glass bottles to be reused.

The GBGB initiative is still in its maturing phase due to its recent initiation (Who’s who, 2010). The initiative was launched in collaboration with other beverage industry efforts to recycle and reuse all types of glass bottles through TGRC. The initiative works with a network of over 1 600 formal and informal bottle merchants nationwide who return or recycle glass bottles. Distell incentivises the return of reusable bottles from the merchants by paying up to four times the price of cullets, which is broken glass. The price paid for a returned bottle can range between 80c and R1.67 depending on the type and size of the bottle (Wine Net, 2010; Antrobus, 2016).

The growing success of the GBGB initiative is evident when looking at the number of glass bottles (in tonnes) that have been returned and reused in Figure 5.1. The increase in returned and reused bottles through the initiative substitutes the purchase of new glass. In 2016, around 149,8 million bottles were reused, representing 28,4% of Distell’s total glass requirement (Distell Group Ltd., 2016b:56). Since Distell already has an established concept of reusing glass bottles in their company, they can provide the information required to identify the parameters required to develop the decision support system for this research.

The recovery of glass bottles starts with the consumer who returns the empty glass bottles to enterprises (i.e. liquor stores and retailers) or informal merchants in exchange for a financial incentive. It is important to have good relations with these enterprises and merchants to ensure that large numbers of bottles are returned since they act as the source of used bottles (Antrobus, 2016; Van den Berg, 2016a).

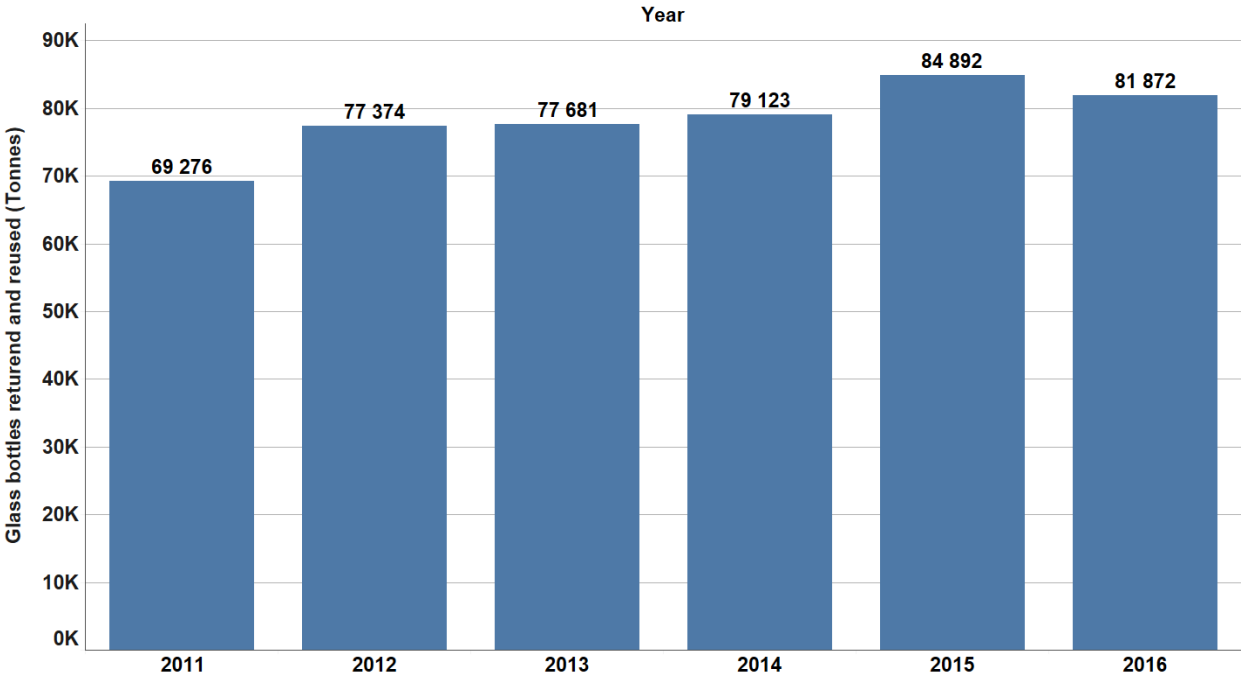


Figure 5.1: Tonnes of glass bottles returned and reused as a result of Distell’s GBGB campaign (Source: Distell Group Ltd., 2016b:56)

The merchants and enterprises collect the bottles until the bottles are accumulated in significant numbers before it is transported to Distell's sorting and washing facilities in Ecowash (Gauteng), Green Park (Western Cape) and Port Elizabeth (Eastern Cape). This system is similar to Kroon and Vrijens' (1995) systems with return logistics' deposit system as discussed earlier in Section 3.4.2. The bottles arrive on pallets and are manually sorted by SKU and re-palletised before they are transported to their washing facilities as illustrated by Figure 5.2 and Figure 5.3.

Figure 5.2: Unsorted bottles stacked in crates on pallets outside the sorting facilities

Figure 5.3: Workers manually feeding the conveyer belt with the various brands that are tagged above the opening on the right

The bottles are machine washed and inspected manually for any defects or residue inside as illustrated by Figure 5.4 and Figure 5.5. After a bottle has passed inspection, it is palletised again by machine and moved to the area on the premises where new bottles are located. Washed bottles must be refilled within 28 days after being washed to prevent any sanitary problems (Karstel, 2016).

Figure 5.4: Unwashed bottles entering the washing machine on the lower level, washed bottles exiting machine on the top level

Figure 5.5: Manual inspection of washed bottles behind light screen for any defects

The glass bottle can be reused multiple times and if the glass is thicker around the contact areas (areas on bottles that are in contact with washing machines), it will increase the number of times the bottle can be reused (Karstel, 2016). To increase the lifespan of a reusable bottle, having a thicker, heavier bottle is recommended. However, the modern trend is to move away from heavier and thicker bottles and replace it with 'lightweight' glass bottles.

The lightweight glass bottles are ideal for one-way glass bottles due to lower transportation costs. However, in the case of this research, the company has to consider using thicker bottles if they want to reuse a bottle that is currently a one-way bottle. Switching from lightweight bottles to heavier bottles will require a large initial investment in glass bottle inventory. Brand X's glass wine bottle is currently a one-way bottle and the next section provides more information on the brand and motivates why it is under consideration for reuse.

5.3 Brand X

As discussed in the previous section, the GBGB campaign increased the number of bottles that are recovered and reused. The question arises whether Distell can further contribute to

sustainable business by adding more one-way glass bottles to the list of reusable bottles. Adding another product to the list has many complications for the owning company.

The complications come in the form of the parameters and characteristics of reusable bottles that influence how successful they can be reused. Therefore, once bottles from a non-reusable brand are considered for reuse, it must have similarities to the bottles of the brands that are currently being reused.

Distell's Brand X, which is currently not sold in a reusable bottle, is showing increasing characteristics and parameters similar to that of Distell's reusable bottles. Brand X has a noticeable presence since it was introduced to the competitive South African wine market. The brand showed great leaps of growth partly due to being sold across South Africa's large urban market (Mettyear, 2016:5). Between 2010 and 2015, it had a growth of 407,5% in sales volume (Mettyear, 2016). What is also worth noting is the fact that Brand X's current sales volume has passed some of Distell's reusable 750 ml glass wine bottles from the same price range (Mettyear, 2016).

An opportunity for research exists to explore whether Brand X is viably reusable due to its sales figures, price category and the growth it has experienced in a competitive wine market. To make such a tactical decision, one would require much more information on the brand. If the brand's bottles cannot be successfully reused, it would have a significant negative implication on Distell's financial situation. An opportunity exists for deeper exploration into the brand's data and other related information before deciding on whether the brand's bottles can sustainably be reused.

5.4 Opportunity for research

Distell provides a platform to study the various parameters that can be used within the DST to evaluate the reusability of glass wine bottles. This can also assist in answering the main research question, which requires the identification of the business logistics circumstances under which it is viable to implement reusable wine bottles. Distell assisted the research by identifying and confirming the relevant parameters to evaluate the reusability of glass wine bottles. The data from their currently reusable glass wine bottles was used to formulate these parameters.

Collecting information on Distell's reusable wine bottles helped the researcher correlate the similarities between Brand X's bottles and Distell's reusable bottles to provide a reliable and valid outcome for the model. To increase the validity of the research, the data on non-reusable bottles with characteristics similar to Brand X's were also added to the DST.

Distell currently has 106 of their brand SKUs being sold in reusable bottles. These are shown in Figure 5.6. Within the 106 reusable SKUs are 30 reusable wine brand SKUs, of which 13 fall into the 1 l and 750 ml categories. This research paper focuses only on the reusable wine bottles that

fall within the 1 l and 750 ml categories because of large differences between parameters and characteristics of the 4.5 l, 2 l and 1,5 l wine bottles. Distell was able to provide the required data on the 1 l and 750 ml reusable wine bottles that allowed exploration of the various parameters that were considered. It also assisted the researcher during the development of the DST.

Figure 5.6: Catalogue of Distell's reusable glass bottles that includes wine, spirits, cider and RTDs (Source: Van den Berg, 2016b)

The information was used to create a database for evaluating and comparing the various reusable glass wine bottles with one another. The evaluation indicated how successful Distell's reusable wine bottles are being recovered and reused. This was done in the DST by indicating the similarities or differences of Brand X's parameters to those of the reusable wine bottles.

Large investment in a company's supply chain and infrastructure is required to reuse their glass bottles on a commercial scale. Distell is currently in a position where the investments have already been made and the infrastructure and supply chain is in place to handle returned bottles on a commercial scale. Having infrastructure and a supply chain that can handle the recovery of glass bottles to be reused is considered a prerequisite for the research because the outcome of the DST is based on the assumption that a company already has a supply chain, skills and necessary infrastructure in place.

Literature provides much information on reusing glass bottles, such as the practices, the infrastructure used, reverse supply chains and legislation. However, the information might not

always be applicable to the South African or Distell's context. Distell's experience and knowledge on reusing glass bottles added a South African perspective to the literature on reusing glass bottles that was discussed in Chapter 3 of this paper. Distell's managers, who have experience in the field of reusing glass bottles, were able to assist the researcher in the development of the DST. They were able to assess which literature and parameters were important and relevant to the research and provides extra information that literature might not have provided.

As discussed in the introduction of this chapter, Distell is a large participant in the South African alcoholic beverage market. This gives Distell the advantage of having economies of scale when implementing a reusing system. To have economies of scale is essential when a company wants to reuse their glass bottles. Smith (2016) from SAB explains that having a reuse system can be very rewarding if it is managed effectively and efficiently. However, it can also become very expensive when the economies of scale do not justify the return leg of the transportation. Distell's economies of scale provide them the opportunity to initiate a project such as the GBGB initiative.

With Distell's revenue in 2016 being R21,5 billion along with an operating profit of 11,3% (Distell Group Ltd., 2016a), the company possesses the needed capital to take on projects such as the GBGB initiative. The company is able to finance the initiative even though it might take a few years for the initiative to prove financially feasible on its own.

To conclude, Distell's unique characteristics make the company ideal for this research:

- Distell already has the infrastructure and supply chain network required for a reusing system.
- Distell's managers have experience, skills and knowledge in the field of reusing glass bottles.
- The company's size allows them to benefit from economies of scale.
- Operating on a large scale provides them with the needed capital to sustain a reusing initiative.
- They possess the required data and information for this research.

When taking all of the factors above into consideration, it would be considered ideal to base the case study on Distell for developing a DST to evaluate the reusability of glass wine bottles. This is in line with Sauter's (2011:321) DST design methodology's situation analysis, which focuses on understanding the organisational setting. The next section discusses the information that was provided by Distell.

5.5 DST inputs

Since the DST was developed to be tested on Distell's wine brands, their experience with reusing glass bottles contributed largely to the development of the DST. Their inputs came in the form of

interviews with key personnel, site visits and sharing of quantitative and qualitative data. This allowed the researcher to achieve the first and second research objectives. The two objectives focus on identifying key decisions and requirements concerning the reuse of glass bottles and identifying the quantitative and qualitative parameters from literature and practice for testing the reusability of glass wine bottles. Therefore, this section is divided into decision requirements, and qualitative and quantitative parameters.

5.5.1 Decision requirements

As stated by Sauter (2011:338) and Taticchi *et al.* (2015:6477), the development of the DST begins by defining the user's needs and defining the problem with their inputs. In Distell's case, the primary requirements and needs from the decision makers within the department of business process improvement included the following:

- Providing a quantitative outcome on whether Brand X's glass wine bottle is viably reusable from a business logistics perspective. If the outcome of the research states that Brand X is viably reusable, more in-depth research will be required as a future research opportunity.
- Use quantitative data that are readily available as opposed to data that must be measured.
- The DST from the research should be able to be reused on other products within Distell.

The three requirements above served as the main guide for this research to derive at an outcome to satisfy the user's needs. It assisted the researcher to design a prototype DST, which is thoroughly explained in Chapter 6. A large part of the DST relies on the input parameters to evaluate the reusability of glass wine bottles. In the next subsection, the qualitative and quantitative parameters that were identified along with Distell and literature are explained in more detail.

5.5.2 Qualitative and quantitative parameters

After studying literature and conducting interviews with Distell's key personnel, it became apparent that a combination of qualitative and quantitative data was required to enable the methodological triangulation of the research. The qualitative data are perceived as the rules, facts and procedures discussed in the previous section under the knowledge-based DST as discussed in Section 4.3. The quantitative data should provide more information on trends and similarities between reusable and one-way glass wine bottles to evaluate their reusability.

5.5.2.1 Qualitative information

The interviews with Distell's personnel made it clear that not all bottles from all brands are fit to be reused. This led to the researcher constructing a list of prerequisites that all one-way bottles

must comply with before they are considered for further evaluation. This is perceived as the rules, facts and procedures from Power *et al.*'s (2002:2) knowledge-driven DST.

The list below contains six prerequisites from interviews and theory that all one-way bottles must comply with in order to be considered for further evaluation in Distell. If one-way glass wine bottles do not comply with all the prerequisites, no further investigation is done on evaluating the bottle's level of reusability.

I. **Is the target market for the product the South African mass market?**
   According to interviews with Van den Berg (2016a) and Antrobus (2016), the mass market of South Africa accounts for the bulk of sales for reusable brands. Selling to the mass market also increases the odds of bottles being returned for a refund since a small deposit on a bottle is regarded as enough incentive to return it.

II. **Are the bottles that will be evaluated a product/SKU owned by Distell?**
   If the bottle is not owned by Distell, it will not be able to enter Distell's existing reusing system. There will also be no deposit from Distell or it will be discarded when entering the sorting facilities (Antrobus, 2016).

III. **Are the bottles' labels washable?**
   At a site visit to Distell's washing plant, Karstel (2016) explained that after bottles are washed, they must be cleared of any foreign materials, including corks, screwcaps and labels. The washed bottles must be identical to a brand new glass bottle coming from the glass manufacturers. Some of the labels on non-reusable bottles are not washable and will cause quality problems in the washing plant's production lines. Even if the labels are not currently washable, replacing it with a washable label without damaging the image of the bottle's brand is just as important.

IV. **Are the bottles made of glass?**
   The durable characteristics of glass allow it to be reused multiple times without any modifications to the glass bottles itself (Golding, 1998:28). During the site visit to Distell's washing plants, Karstel (2016) stated that a bottle that is being reused does not necessarily have to be a thick and expensive glass bottle. If bottles have high return rates, it can be replaced over time by a thicker and more durable glass bottle to increase the reusable bottles' lifespan.

V. **Is the brand a RTD product?**
   When a product is a RTD product, it is generally consumed in a shorter amount of time (Van den Berg, 2016a). This decreases the time from purchase to time of return when compared to spirits, which is consumed over a longer period. When a product is returned in a shorter period, it will increase the overall inventory turnover rate.

VI. **Is it bottled in South Africa for shorter return distance?**

Keeping the bottles in the South African market assures the reusing company that there will be no international long haul journeys for recovering their used bottles (Van den Berg, 2016a). This will keep the complexity and overheads of the return logistics to a minimum.

A one-way bottle that is considered for reuse must comply with each of the items on the list above. A simple 'yes' or 'no' answer to the items on the list will determine whether further investigation should take place. For example, if a one-way bottle has just one 'no' out of all the items on the list, it will not be considered for further investigation. A one-way bottle that has a 'yes' for each item on the list assures the decision makers that the bottle's circumstances are aligned for being reused within the South African context. If a one-way bottle complies with all the prerequisites, more information on its quantitative information is required, which is discussed in the following section.

5.5.2.2 Quantitative information

Providing a quantitative outcome on whether Brand X's glass wine bottle is viably reusable from a business logistics perspective is one of Distell's decision-making requirements. The researcher studied the literature and conducted interviews to identify the quantitative parameters for evaluating the reusability of glass wine bottles from a business logistics perspective. The identified quantitative parameters are explained below by indicating the formula that is used to calculate the parameter's outcome and the significance of the parameter for this research.

I. The **return rate** on products is considered to be one of the most important indicators for evaluating the effectiveness of existing reverse logistic systems according to interviews with Van den Berg (2016a), Morse (2016) and Smith (2016). The parameter is a percentage calculated based on the number of a brand's bottles that is deemed for recovery that are returned vs. the number that are being sold for the same financial year:

$$\frac{\#\ Returnable\ bottles\ recovered}{\#\ Returnable\ bottles\ sold} \times \frac{100}{1}$$

Having a large return rate indicates that fewer reusable bottles have to be purchased to replace the ones that are not returned. According to Van den Berg (2016b), Distell has a minimum required return rate of 80% for all their returnable brands across their wine, spirits, cider and RTD products. Reusable bottles are in general more expensive than one-way bottles since they have to be more durable, requiring thicker glass (Karstel, 2016).

II. **The average retail price per bottle** for each brand is calculated to compare how much value for money the consumer receives for each bottle they buy. According to Van den Berg (2016a) and Antrobus (2016), the mass market that is responsible for most of the

returned bottles buys Distell's products that give them more value for money. If a product's price per bottle is low in comparison to the other products' prices, it means that the product offers better value to the consumer for his/her money.

III. **The deposit as a percentage of the selling price** is considered an important parameter to examine the likelihood of a bottle being returned by the consumer. This is especially applicable to the mass market of South Africa where a small deposit on a bottle will serve as enough motivation for consumers to return it to a shop or a merchant (Jhetam, 2016).

The calculation for this parameter is done by dividing the deposit on a bottle by the average retail price and multiplying it by 100 to reach a percentage. Distell has a minimum required deposit as a percentage of selling price of 3% (Van den Berg, 2016a). The equation is illustrated below. A larger percentage is preferred when bottles are being reused.

$$\frac{Product's\ deposit\ amount\ (ZAR)}{Product's\ average\ retail\ price\ (ZAR)} \times \frac{100}{1}$$

IV. **The number of bottles sold** can be related to the initial investment in reusable containers and system cost that has to be incurred by the owning company (Mollenkopf, Closs, Twede, Lee & Burgess, 2005:172). As the monthly volume increases, the overhead cost per bottle decreases. Economies of scale play an important role in having an effective and efficient reuse system, since large overhead costs are involved when reusing (Smith, 2016).

The number of bottles sold parameter uses the number of bottles sold per brand for the same year. Historical data from each brand for five consecutive years are used to indicate any trends leading up to the current sales volume. The number of bottles sold indicates whether the bottle is capable of providing economies of scale when it is considered for reuse.

V. **The level of standardisation** of a brand indicates how many bottle SKUs are trading within a brand. When a brand only has one SKU in circulation, it will have a higher level of standardisation than a brand that has two or more SKUs in circulation. When a brand has more than one bottle SKU in circulation, the bottle might have the same shape, but different colours, such as flint for white wine and green for red wine (Van den Berg, 2016a). According to Ko, Noh and Hwang (2012:693), companies that use more standardised bottles benefit in three ways:

1. Less labour is required to sort the bottles, which in effect reduces costs.
2. Costs are reduced because of the streamlining of collection and reuse processes.

3. A company's inventory holding costs and lost sales cost are reduced via inventory pooling.

One shortcoming of this parameter is that one should also calculate the sales ratio between the SKUs within the brand**.** If one SKU within a brand has significantly more sales than the other(s), the overall standardisation is considered to be higher. This information was not available to the researcher and therefore shall be considered as a recommendation for future research.

VI. **The inventory turnover rate** is a world-class performance indicator that focuses on the production performance of a product (Demeter & Matyusz, 2011:156). It illustrates the amount of inventory that is sold over a given time period. A high inventory turnover rate indicates that more sales are being generated given a certain amount of inventory and it is calculated as follows (Fuhrmann, 2014):

$$\frac{Cost\ of\ goods\ sold\ (ZAR)}{Average\ inventory\ (ZAR)}$$

The outcome of this calculation indicates which of Distell's brands are being sold at higher rates in comparison to others for the financial year. A high inventory turnover rate is preferred for a reuse system. It indicates an effective and efficient reuse system, which in turn lowers the overhead cost per product.

VII. **The estimated returns per region** parameter is an additional consideration and a stand-alone parameter. This means that it is not included in the output sheet of the DST's model component to be compared to other brands. However, it remains relevant for the outcome of this research. The parameter was identified from interviews with Distell's business improvement manager, who placed great emphasis on the various regions having different return cultures, which plays an important role in the overall success when there is a reuse system in place. The parameter attempts to quantify the 'return culture' of the various regions in South Africa. The outcome of the parameter provides an estimation on the number of returns that can be expected for Brand X.

The parameter is based on the current return rate of all the reusable wine brands for three different regions within South Africa. Distell divide the regions into the Southern (Western Cape, Northern Cape and Free State), Coastal (Eastern Cape and KwaZulu-Natal) and Northern and Central (Gauteng, North West, Limpopo and Mpumalanga) regions.

The calculation is done by dividing the total number of reusable wine bottles that were recovered per region by the total number of reusable wine bottles sold in the same region for the 2015 financial year. The outcome of the calculation is the return rate per region. The return rate per region provides an indication of the region's 'return culture', A region

that is accustomed to returning their empty bottles is considered as a region with a good 'return culture' (Jhetam, 2016), which is favourable when a company wants to reuse their containers.

The calculation continues by using Brand X's sale figures for each region for the 2015 financial year. The estimated returns per region for Brand X is calculated by multiplying the return rate per region by the number of Brand X bottles sold per corresponding region.

To derive at the parameter's outcome, the total estimated returns of Brand X bottles are divided by the total number of Brand X bottles sold. The parameter's outcome is the estimated return rate in percentage for Brand X in South Africa. The outcome should not be taken literally since numerous and unpredictable factors still have to be taken into account. However, the parameter provides an indication of whether significant amounts of Brand X bottles are currently sold in areas that are accustomed to returning empty glass wine bottles.

Serving the high return rate regions with significant amounts of Brand X wine will be considered a favourable outcome for the final decision makers. One also has to consider the distance between the areas where the bottles are filled and the market it serves. Most of Distell's spirits, cider and RTD bottles are filled close to the market it serves, which favours the recovery and reuse of their bottles. Wine is primarily made and bottled in the Western Cape. If there are great demands for Distell's wine in the Northern region of South Africa, it will increase the transportation cost of returning the recovered bottles.

The DST is not limited to the six quantifiable parameters and the stand-alone parameter discussed above. One of the parameters which literature proposes as important is the cycle time of the brand's bottles between supplier and customer. The cycle time includes the total time of transport to and from the customer, dwell time prior to use and the time to build consolidated loads for returns (Mollenkopf *et al.*, 2005:172). A lower cycle is favourable since a shorter cycle time leads to a lower initial investment into container inventory and payback period on reusable containers can be shortened (Mollenkopf *et al.*, 2005:172).

It is difficult to measure the cycle time since individual bottles are hard to trace as it moves through a company's distribution system, and Distell does not have the required information on hand. The parameter would also have been limited to only measuring the reusable bottles' cycle time since a non-reusable bottle cannot provide information on the return time.

The last parameter that theory regards as important for measuring the reusability of glass bottles is the season variation in demand, which indicates the number of 'float' inventory a company should have in storage. The float inventory is the extra number of bottles in circulation and storage that is required to support a refillable system (Office of Technology Assesssment Materials Group,

1979:281). More inventory is required if a certain SKU has large peak demand periods leading to large additional costs and inefficiencies in the return logistics system (Incpen, 2010). Distell's managers did not regard this information as important for evaluating the reusability of glass wine bottles and therefore it is regarded as a parameter to be investigated in future research.

5.6 Summary

Combining Brand X's increasing similarities to reusable glass wine bottles and Distell's experience with the reuse of glass bottles creates a good platform on which to conduct this research. Distell's experience and knowledge assisted in the identification of the decision requirements and the qualitative and quantitative parameters from literature and practice for testing the reusability of glass wine bottles. This helped to achieve the first and second research objectives. The next section focuses on developing the DST. The qualitative and quantitative parameters that have been identified have to be built into the DST to draw at a valid and reliable conclusion.

Chapter 6 – The development and implementation of the DST

6.1 Introduction

Chapter 6 focuses on the development and implementation of the DST. The chapter is divided into a development and an implementation section. The development section focuses on the frameworks that were selected as relevant to this research from literature to develop the DST. It also discusses the physical construction of the decision support tool under the themes of the three DST components, i.e. the data-, model- and user interface components. The implementation section explains how the DST was populated with the appropriate data and how the findings can be presented to the decision maker.

6.2 DST development

The development of the DST begins by defining the user's needs (Sauter, 2011:338) and defining the problem with their inputs (Taticchi *et al.*, 2015:6477), which was done in the previous chapter. From this information, the researcher designed a prototype that was evaluated by Distell based on their decision needs and requirements. The tool was adjusted and presented to the decision makers for testing and evaluation. This process was repeated three times, until the decision makers were satisfied with the tool and the final product was made available to them.

Going through this process improved the validity and reliability of the final tool. The selected design approaches, development frameworks, along with Sauter's (2011) and Tennant and Friend's (2005) design and development stages deriving from the literature of Section 4.2, Section 4.3 and Section 4.4 were followed to develop the final DST.

6.2.1 Design approach and development framework

The design approach and framework chosen for this research must be aligned with the requirements and key decisions from the final decision makers of Distell. Chapter 4 contains literature from books and journal articles focusing on the development of a DST that is in accordance with the requirements and key decisions of Distell. In order to develop the DST for evaluating the reusability of Distell's Brand X glass wine bottle, one should take the correct design approach.

6.2.1.1 The design approach

Three approaches were identified from the literature. These include the: 1) one-stage, complete system; 2) quick-hit method; and 3) evolutionary method. All three of the approaches were evaluated based on Distell's requirements and key decisions. From the three approaches, the quick-hit method was identified as the design approach that is most suitable for this research.

According to Sauter (2011:337), the quick-hit method is used when the goals and procedures are clear, the data are available and the system can operate independently while there is little need to address conflicting concerns.

In the case of this research, the goals set out by Distell are clear and explained in Section 5.5.1. The quantitative and qualitative data that are required for the DST to produce the required outcome is available, either in Distell's electronic databases, or has been obtained using interviews with relevant key role players in the industry. Finally, the tool was developed to operate independently because the researcher is doing the designing and development in a single study from an outside perspective and not within the company. With these criteria in place, the quick-hit method design approach fits as the preferred approach for this research.

Sauter (2011:337) continues to explain that the quick-hit method design approach is a good candidate when it concerns a decision in business that is not made often. Evaluating the reusability of glass wine bottles with the intention to reuse a one-way glass bottle on a commercial scale is not an everyday decision. The consequences of such a decision could have great implications for the owning company if it proves to be unsuccessful. Large investments in infrastructure, glass bottles fit for reuse and awareness campaigns are some of the major costs associated with reusing glass bottles in general.

Distell already reuses some of their spirits, cider, RTD and wine bottles on a commercial scale, thus some of these investments have already been made to set the reusing systems in place. Adding another bottle that is not currently being reused to their catalogue of reusable bottles requires a deep and thorough investigation before a final decision can be made. The DST deriving from this research is considered an initial of various tests that a glass wine bottle will have to undergo before a final decision can be made on whether it should be reused in practice.

6.2.1.2 DST framework

Having decided on a design approach, a framework should be followed to guide the researcher through the construction phase of the DST. Power *et al.* (2011) identifies seven different sets of frameworks, discussed in Section 4.3, categorising the large number of computerised systems that supports decision making. Out of the seven frameworks proposed by Power *et al.* (2002; 2011), a combination of three frameworks were used for the purpose of this study. The three frameworks have been identified as the 1) knowledge-driven; 2) data-driven; and 3) spreadsheet-based DST.

The knowledge-driven DST is selected for this research based on the person-computer system platform it offers. The framework provides specialised expertise in the form of rules, facts, procedures and similar structures (Power *et al.*, 2002:2). These 'expertise' consists of knowledge within a particular field, understanding of the problem within the field and the skills required for

solving the problem. The expertise was used to set up qualitative prerequisites that glass bottles must comply with before it can be evaluated within the DST as discussed in Section 5.5.2.1.

The data-driven DST is focused on the data component of the tool. The framework provides access to and manipulation of large databases of structured data and time-series of internal company and external data (Power, 2002:13). The quantitative parameters identified for the DST required data on the reusable and non-reusable glass wine bottles that Distell owns. Historical quantitative data on the bottles were also required to indicate any trends or patterns within the data series.

The spreadsheet-based DST is used when a DST is implemented using a spreadsheet package such as Microsoft Excel (Power, 2011). Most managers know how to work on Microsoft Excel (Power, 2011), therefore a large part of the DST model component's construction is done within Microsoft Excel. The data required from Distell was also obtained in Excel format, allowing it to be easily transferred onto the spreadsheets that have been designed by the researcher.

To conclude, a combination of the knowledge-driven, data-driven and spreadsheet-based frameworks was used to form the basis for developing a DST to evaluate the reusability of glass wine bottles for this research. The next section explains the construction of the DST for this research. The construction was done based on the guidelines set out by the design approach as well as frameworks selected to develop the DST.

6.2.2 Construction

The construction section explains the complete development of the DST in terms of its three main components. The three components consist of the data-, model- and user interface component. The data component describes the data that are required to formulate the parameters for evaluating the reusability of the glass wine bottles and the reusability of Brand X's glass wine bottle. The model component section explains how the parameters are used within Microsoft Excel to provide an outcome on the various wine bottles evaluated by the DST. Finally, the user interface component section elaborates on the methods used to display the outcome of the data- and model component to the decision maker.

6.2.2.1 Data component

Sauter (2011:69) states that business analytics and business intelligence efforts depend on data, therefore, without data, there can be no business analytics and no improvement on decision making. The data that are acquired should reflect historical, current and predictive views of the case company and its environment. As discussed earlier, a combination of qualitative and quantitative data was used within the data component of the DST to increase the methodological triangulation of the research.

Qualitative information

To review the discussion from Chapter 5, the rules, facts and procedures within the qualitative data component of the DST construction section are considered as prerequisites that one-way bottles must comply with before it is considered for evaluation with regard to reusability. The list in Table 6.1 contains the six prerequisites that all one-way bottles must comply with in order to be considered for further evaluation by Distell.

Table 6.1: List of prerequisites one-way glass bottles

No.	Prerequisites	Yes/No
I.	Is the target market for the product the South African mass market?	
II.	Are the bottles that will be evaluated a product/SKU owned by Distell?	
III.	Are the bottles' labels washable?	
IV.	Are the bottles made of glass?	
V.	Is the brand a RTD product?	
VI.	Is it bottled in South Africa for shorter return distance?	

If a one-way bottle complies with each of the six prerequisites, it will assure the decision makers that the bottle's circumstances are aligned for being reused within the South African and Distell's context. The qualitative data of this research assists in guiding the overall design of the DST with the prerequisites above. The quantitative section of the tool is used for the more detailed analysis of the DST (Sauter, 2011:40).

Quantitative information

This section depicts the quantitative parameters that were identified in Chapter 5. The seven parameters are listed in Table 6.2, which includes the parameters' measuring unit as well as the data required from each of the brands that are measured. The data that are required by the DST were already available in Distell's databases, which is in line with their decision requirements referring to the use of readily available quantitative data as opposed to data that must be measured.

Table 6.2: DSTs identified parameters with measuring unit and data required

Number	Parameter	Unit of measure	Data required
I	Return rate	%	Number of returnable bottles recovered in base year[2]
			Number of returnable bottles sold base year
II	Average retail price per bottle	Rand (ZAR)	Average retail price per bottle for each brand (ZAR)
III	Deposit as % of selling price	%	Deposit amount per bottle (ZAR)
			Average retail price per bottle (ZAR)
IV	Number of bottles sold	Units	Number of bottles sold for base year and five years leading up to base year
V	Level of standardisation	units	Amount of SKU's within a brand's product range
VI	Inventory turnover rate	Times	Cost of goods sold for base year per brand (ZAR)
			Average inventory value for base year per brand (ZAR)
VII	Estimated returns per region	%	Total number of reusable wine bottles per brand sold in each corresponding region
			Total number of wine bottles recovered per region
			The total number of Brand X's glass wine bottles sold in each corresponding region

The parameters listed above are focused on quantifiably measuring the reusability of glass wine bottles from a business logistics perspective. After the data from the quantitative parameters had been requested from Distell, it was transferred from Distell's data base to the researcher's data base.

The next step was to clean the data since they derive from various internal sources and have to be built into a unified framework (Sauter, 2011:93). The cleaning process for this research consisted of formatting the data to increase the standardisation of data in the tool and checking the spelling of data fields and ensuring that undesirable characters were removed. Using organised data in the tool helps to prevent errors in the outcome of the DST. The next subsection explains the model component and how it is linked with the data component.

6.2.2.2 Model component

The model component simplifies and abstracts detailed data. It processes and summarises large sets of data to allow important patterns to emerge (Sauter, 2011:125). Tennant and Friend's (2005) six-step model development process that is discussed in Section 4.4.2 is followed to construct the model component of the DST. The purpose of the model is to represent critical relationships in such a way as to guide decision makers towards a desired goal. Following

[2] Base year refers to the most recent, completed financial year for which all data are available. The 2015 financial year was the base year for this research.

Tennant and Friend's (2005) development process map assures the reliability and validity of the model component. In this subsection, only steps 1 to 5 are followed. Step 6 requires the user interface to be developed and user testing to be done. This step is discussed in Section 6.2.2.3 and Section 6.3 respectively.

Step 1 and 2: Set up input and output templates and populate input templates with test data

The model development process begins by setting up the input and output templates in Microsoft Excel (Tennant & Friend, 2005:33). The Microsoft Excel spreadsheets represent the model component of the DST in this study. The completed input and output templates can be viewed in Appendix C and Appendix E at the end of this research. Alternatively, screen clippings are also provided within this subsection for demonstrative purposes. The templates consist of the following, and will each be described in more detail below:

- A main data input template that requires all the data from the reusable brands that will be used throughout the whole DST (see Table 6.3)
- An evaluation input template where the non-reusable brand's data will be entered that will be used throughout the whole DST (see Table 6.4)
- A weight attribution input template (see Table 6.5)
- The DST output template (see Table 6.6)

The main data input template and evaluation input template contain the cells into which the data from the reusable brands and non-reusable brand being evaluated should be entered. The cells from the two input templates that require the reusable and non-reusable brands' data are highlighted in blue, while also including an example of the data that are required in the top cell row required as illustrated in Table 6.3 and Table 6.4. The example data increases the user friendliness of the DST by providing an example of the format of the data that is required as well as an expected indication of the data value. The tables contain test data that were used to assist the researcher to estimate the effectiveness and accuracy of the tool before Distell's data were made available.

Table 6.3: Reusable brands' input template (table contains hypothetical test data)

Reusable wine brands	Number of bottles sold (CY/FY)	Number of bottles recovered	Deposit per bottle (ZAR)	Average retail price per bottle (ZAR)	Average COGS	Average inventory value	Number of SKU's within brand
Example Brand	570 661	378 103	R 2.50	R 32.00	R 6 428 549	R 684 793	2
A	764 278	506 388	R 1.80	R 32.00	R 8 609 663	R 917 134	1
B	3 203 370	2 626 091	R 1.80	R 35.00	R 33 604 897	R 1 605 524	2
C	974 528	711 357	R 1.80	R 19.00	R 10 014 815	R 4 602 526	3
D	3 374 013	2 235 520	R 1.80	R 22.00	R 33 499 836	R 3 483 974	1
E	19 300 719	15 822 536	R 1.80	R 25.00	R 197 026 505	R 23 160 863	1

As Table 6.3 illustrates, all the reusable brands' names have been changed to alphabetical letters by Distell to keep their brand information confidential. In this research, Brand A to E represents

reusable wine bottle brands Brand X is the non-reusable brand of this research that is being investigated.

Table 6.4: Non-returnable brand's Excel evaluation input template

Brand under consideration	Number of bottles sold in FY	Deposit per bottle (ZAR)	Average retail price per bottle (ZAR)	Average COGS	Average inventory value	Number of SKU's within brand
Example brand	*1 365 894*	*R 1.54*	*R 28.58*	*R 25 839 574*	*R 18 570 285*	*2*

The motive behind keeping the two data input templates of the reusable and non-reusable brands separate is to allow data from various non-reusable brands to be swiftly tested in the DST while keeping the data from the reusable data input template constant and secure. For future use, it will allow other companies' brand data to also be tested with the DST without compromising or manipulating the sensitive input data from the reusable bottles since Microsoft Excel allows the hiding or locking of input sheets.

The importance of each individual parameter differs due to its contribution towards evaluating the reusability of glass wine bottles. Taticchi *et al.* (2015:6477) state that when doing a multi-criteria decision analysis against various alternatives, a weighting should be obtained to calculate an overall score for each alternative. The weight attribution input template's information was obtained through an online survey that was sent out via e-mail to various decision makers within Distell to provide a weighting to each of the quantitative parameters. The online survey can be seen in Appendix B of this research.

The importance weight is a subjective vector given by Distell's decision makers for each parameter. The vector consists of a scale rating ranging from 1 (not important) to 5 (very important) for each parameter, as well as 0 (not applicable). The input values can be argued and updated by the management team on a regular basis to ensure that it is up to date with the company's current situation. The information obtained through a survey, but other methods can be followed to review this. The average weight per parameter was calculated and then converted to an average out of 100 to allow easier management of the data. An example of the weight attribution input template can be seen in Table 6.5. The converted average is used in the output template.

Table 6.5: Importance weighting inputs by Distell's decision makers in different departments (table contains hypothetical test data)

	Department's weight attribution						
Parameter	Marketing	Business Improvement	Distribution (1)	Other	Distribution (2)	Average	Converted Average
Return rate	5	4	4	4	4	4.2	84
Average retail price per bottle	0	3	3	3	5	2.8	56
Deposit as % of selling price	4	1	5	4	4	3.6	72
Number of bottles sold	4	3	2	4	3	3.2	64
Level of standardisation	3	5	1	2	4	3	60
Inventory turnover rate	3	4	3	2	1	2.6	52

Finally, the output template contains the outcome from each brand's parameter along with each parameter's weight attribution linked to the blue shaded areas as illustrated in Table 6.6. The total score is calculated by multiplying the score deriving from the parameters' input templates by the parameters' weight attribution. As the table illustrates, two levels of reusability are calculated by adding up the total scores.

Table 6.6: DST output template for one reusable brand (table contains hypothetical test data)

Brand	Parameter	Weight	Score	Total score
A	Return rate	76	0.15	11.20
A	Average retail price per bottle	68	0.14	9.69
A	Deposit as % of selling price	64	0.13	8.36
A	Number of bottles sold	68	0.03	1.73
A	Level of standardisation	80	0.19	15.00
A	Inventory turnover rate	72	0.17	12.36
A	**Level of reusability**			**58.34**
A	**Level of reusability excluding return rate**			**47.14**

The level of reusability is calculated to compare returnable brands with one another. The 'level of reusability excluding return rate' is used to compare reusable and non-reusable brands with one another since a non-reusable brand does not have a return rate yet. The two levels of reusability can vary greatly depending on the input data deriving from the parameters. To place the outcome on the level of reusability of this research in perspective, a brand that does not perform well will have roughly 43, a good level of reusability is more or less 82 while an average level of reusability is 67. These figures are based on the information supplied by Distell. In summary, the three important outcomes of the DST's output template are:

1. The total score – used to compare the brands' parameters to one another
2. Level of reusability – used to compare returnable brands with one another
3. Level of reusability excluding return rate – used to compare returnable and non-returnable brands with one another.

Step 3 and 4: Create working pages for all main sections and develop calculations and transfer results to output sheets

Each parameter that has been identified for evaluating the reusability of glass wine bottles has its own working page or input template within the model component. Each parameter input template contains the codes and formulas of the associated parameter. The formulas are pre-entered into the Excel input sheets for each parameter that have been identified as relevant for this research. The calculated fields are linked to the reusable and non-reusable brands' input templates, which contain all the required data. Each parameter's input template can be viewed in Appendix D at the end of the research. Alternatively, screen clippings are also provided within this subsection for demonstrative purposes.

The output template discussed earlier requires the score from each brand's parameter. A parameter's score is calculated by adding up the outcome from all the brands' parameters. Each parameter's outcome is then divided by the sum of all the parameters' outcomes to give it a score. In the case of Table 6.7, each brand's inventory turnover rate is added up to derive at the total of 54.69. To calculate Brand A's score, Brand A's inventory turnover rate of 9.39 is divided by the total of 54.69 to derive at the score of 0.17. As the table illustrates, the higher the inventory turnover rate, the higher the score.

Table 6.7: Input template for the inventory turnover rates parameter (table contains hypothetical test data)

Brand	Cost of goods sold (ZAR)	Average Inventory (ZAR)	Inventory turnover rate	Score
A	R 5 739 776	R 611 422	9.39	0.17
B	R 22 403 265	R 1 070 349	20.93	0.38
C	R 6 676 543	R 3 068 351	2.18	0.04
D	R 22 333 224	R 2 322 650	9.62	0.18
E	R 131 351 004	R 15 440 575	8.51	0.16
Brand X	**R 20 994 881**	R **5 156 580**	**4.07**	**0.07**
Total			**54.69**	

There are some cases where a higher outcome from a parameter, such as average retail price, is considered as an unfavourable outcome. In such a case, the reciprocal value should be used. The reciprocal value reverses order among values of the same sign and converts the largest value to the smallest and vice versa by inversing the outcome from the relevant parameters (Cox, 2007). The reciprocal value is used to support the integrity of the model's outcome by preventing high values that benefit underperforming brands to disrupt the data while keeping it in balance with one another.

Table 6.8 provides an example where the reciprocal value is used. To calculate Brand A's score, its average retail price of 30 is inverted to a reciprocal value of 0.0333 by using the following formula:$(average\ retail\ price)^{-1}$. The reciprocal value is used as the parameter's outcome. All the brands' reciprocal values are added up to derive at 0.2. Brand A's score is then calculated by dividing its reciprocal value of 0.033 by 0.2, which gives it a score of 0.16. Table 6.8 illustrates that Brand D, which has the lowest average retail price, achieved the highest score.

Table 6.8: Input template for the average retail price parameter requiring reciprocal value to be calculated (table contains test data)

Brand	Avg retail price	Reciprocal value	Score
A	R 30.00	0.033	0.16
B	R 31.00	0.032	0.16
C	R 32.00	0.031	0.15
D	R 27.00	0.037	0.18
E	R 34.00	0.029	0.14
X	**R 24.00**	0.042	**0.20**
Total	**178.00**	**0.20**	

Step 5: Test and debug. Develop the user interfaces and conduct user testing.

Before the user interfaces and user testing can be done, the whole DST must be tested and debugged (Tennant & Friend, 2005:33). The test data that were used while the researcher waited for the requested data from Distell proved to be useful for testing and debugging the DST. Attending any mistakes before the real data were used ensured the technical accuracy and logic of the model component. The next step was to develop the user interface and test the DST with Distell's decision makers.

6.2.2.3 User interface component

The user interface component, also referred to as the dashboard, is the communication application between the human and computer. It is important that it includes all the mechanisms by which commands, requests and data are entered into the DST (Sauter, 2011:216). The user interface is designed to be user-friendly so that the decision makers can easily navigate their way through it to find the desired outcomes in order to support their decisions. A range of business intelligence tools are available to be used as the user interface component, but for this research, Tableau was primarily chosen to represent the user interface, while Microsoft Excel represents a secondary part of the user interface.

Tableau was chosen as the user-interface component of this research since it provides a user-friendly platform that effectively displays the data deriving from Microsoft Excel. Distell does have access to the programme. However, since the data are already available in the correct format in Microsoft Excel, it is does not have to be presented by Tableau, but can be presented by the data visualisation programme of the decision maker's choice.

The evaluation input template, which has already been discussed in the previous subsection, represents the Microsoft Excel user interface component. The required data from the brand under consideration are entered into the evaluation input template where the cells are formatted by colour to provide a preconception of how the non-reusable brand's input data compares to the reusable brands' data. The colour format serves two purposes.

The first purpose is to indicate whether the data entered into the input template are in line with the profile of the reusable bottles. The second purpose is to indicate whether the data that are entered is within the bounds of the reusable bottles' data for each required input cell. A cell that is remarkably red or green is an indication of a data point that is considered to be an outlier and it should be re-checked to ensure the accuracy of the data. A yellow cell is an indication of data that are in line with the average of the reusable bottles' data.

Figure 6.1 illustrates the evaluation input template with non-reusable brands F to I. This data from currently non-returnable brands were used to verify that the DST's outcome was valid and reliable

by indicating that these non-returnable brands are not viably reusable from a business logistics perspective.

Brand under consideration	Number of bottles sold in FY	Deposit per bottle (ZAR)	Average retail price per bottle (ZAR)	Average COGS	Average inventory value	Number of SKU's within brand
Example brand	*1 365 894*	*R 1,54*	*R 28,58*	*R 25 839 574*	*R 18 570 285*	*2*
F	2 004 898	2,66	23	1 822 151	R 194 102	2
G	1 912 398	1,56	30	7 112 148	R 339 793	3
H	935 294	2,07	26	7 089 912	R 737 349	2
I	1 328 569	1,61	34	14 698 731	R 1 901 770	1

Colour legend:
Good Bad

Figure 6.1: Example of the Excel evaluation input template with formatted colours (figure contains test data)

The evaluation input template does not provide a thorough enough display of a non-reusable brands' performance in comparison to other reusable brands. Therefore, the Tableau user-interface was used to provide a more effective display.

Tableau displays scorecards designed with various colour combinations and the placement of separate input and output windows to display the data deriving from the Excel templates effectively. The goal of the scorecards is to present organised data to the decision maker in a logical format. Special attention is given to the scale of the graphs and charts that are used in the dashboard to avoid representing the quantitative data inaccurately. An example of the output data exported to the user interface component can be found in Figure 6.2. This was repeated for all the parameters. A bold blue cross represents the reusable brands' total score, while a bold green cross represents the non-reusable brand.

Since the dashboard has access to the complete Microsoft Excel output template, all the relevant data can easily be sorted in the user interface component to present the required information. On the top right side of the figure are all the brands that are available to be presented in the dashboard. In the middle right side are the parameters discussed earlier in this chapter, which are displayed for selection. The legend is provided on the bottom right of the figure. The layout of the user interface component provides the decision makers with a user-friendly way to navigate their way through the data to arrive at the desired parameter outcome easily.

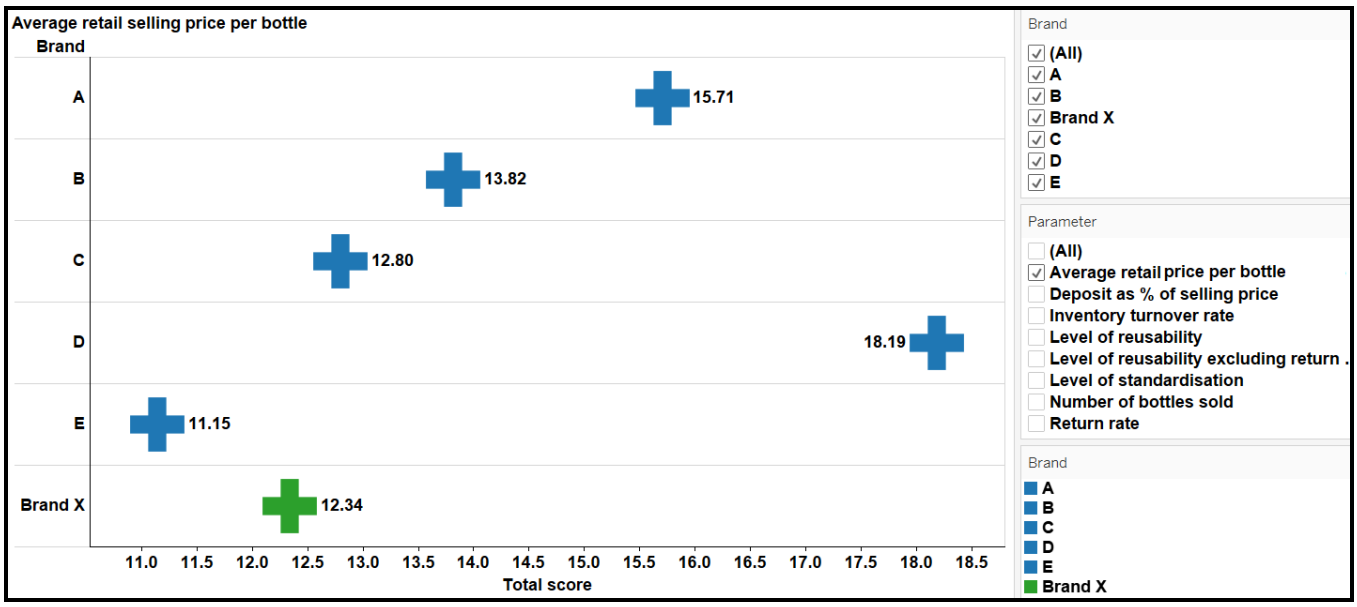


Figure 6.2: Screen clipping from Tableau: dashboard for average retail price parameter. Screen clipping contains test data

6.3 DST implementation

According to Sauter (2011:382), the two ways to know that the implementation of the DST is a success is when the technical requirements of the system are achieved and the system as a whole is useful to the subject to logically analyse the problem. Doing this requires the final DST to meet a recognised need and to provide a well-informed or good answer to decision makers (Sauter, 2011:387). In the implementation phase, the DST was populated with the acquired data and then it was presented in a functional and user-friendly manner to Distell.

6.3.1 Populating the DST with data

As discussed earlier, the decision support tool was first populated with test data to ensure the logic and accuracy of the DST. It was also important to be cautious of so-called bugs within the DST and to make sure that no mistakes such as a typographical errors were made while populating the tool with data during the implementation stage. As the data from Distell arrived, the model was populated with the required data to derive at the desired outcome.

6.3.2 Presenting the findings

As mentioned earlier, the DST was first presented to the research supervisors to identify any improvements or faults that the tool could have before it was presented to Distell's decision makers. The adjustments from the study leaders' feedback were made and the DST was presented to Distell's decision makers with the test data to illustrate its functionality. The decision makers were pleased with the DSTs functionality to provide a quantifiable outcome on whether a brand is viably reusable from a business logistics perspective.

After populating the model with Distell's data, the outcome of the model had to be presented in a functional and user-friendly way to be useful for the decision maker. The data from the parameters were processed in Microsoft Excel and transferred to Tableau for visual purposes. After presenting the outcome of the DST to Distell's decision makers, they agreed that the outcome was in line with their expectations and that the outcome on whether to reuse Brand X was reliable. The findings of the DST and the decision makers' comments are presented and thoroughly discussed in the next chapter.

6.4 Summary

Research objectives number three and four were accomplished in Chapter 6. The third research objective required the various DST frameworks from Chapter 4 to be evaluated to find the most suitable framework for this research, while the fourth research objective required the frameworks to be used in order to develop the DST for evaluating the reusability of glass wine bottles. Chapter 7 accomplishes the fifth and final research objective, which requires the DST to be tested at the hand of Distell's Brand X to determine its viability for reusing and make recommendations on whether to implement reusable bottles for Brand X based on the results deriving from the DST.

Chapter 7 – Discussion of findings

The previous chapter focused on executing Phase 3 of this research as illustrated in Figure 7.1. In this chapter, Phase 4 was implemented, which required the DST to be tested within the case company. The outcome on whether Distell's Brand X is viably reusable from a business logistics perspective is discussed at the end of Section 7.3.3.

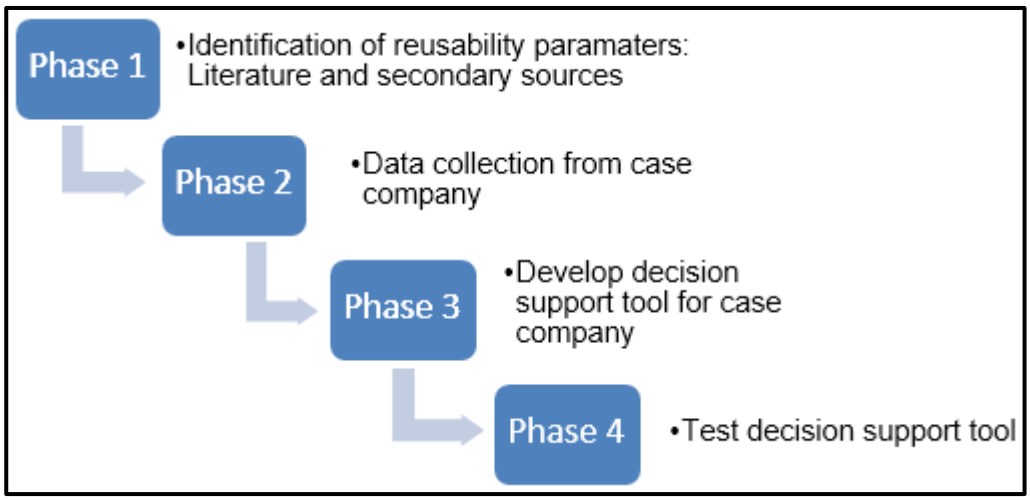


Figure 7.1: Four phases of the research methodology research process

To present the findings from the DST, Chapter 7 is divided into three main sections. The first two sections are divided into the DST's 'Input templates' and the 'Output template'. The input template section contains a discussion, analyses and synthesises on the outcome from each of the identified qualitative and quantitative parameters. The output template section discusses the reusable and non-reusable brands' level of reusability. The third section evaluates the validity and reliability of the DST's model component, data component and findings.

7.1 Input templates

Before the data were obtained from the case company, a few pilot tests were done on the DST's model component with test data. The test data proved to be valuable since it assisted with eliminating bugs and defects that improved the overall functionality of the model. By doing this, the real data from the case company were entered into the model without any time delay or adjustments to the overall model component of the DST.

The input templates section starts with the qualitative parameter to indicate whether Brand X complies with all the prerequisites. The first quantitative input template that is discussed is the Excel evaluation input template. The decision maker entered all the required data from the non-reusable brand being evaluated into this template. The data were then exported to all the parameters' input templates in Excel for evaluation.

The following part of the section discusses the weight attribution for the various parameters from Distell's decision makers. Following the discussion on the weight attribution is a discussion on each quantitative parameter. The parameters are discussed by providing a short review on the parameter being discussed along with a screen clipping on the outcome of the parameter from the user-interface component to support the discussion, analysis and synthesis.

7.1.1 Prerequisites

The prerequisites represent the qualitative data of the DST. Any brand that is considered for reuse, must comply with all the prerequisites listed in Table 7.1 before any further evaluation can be done on whether it is viably reusable from a business logistics perspective. The table was discussed with Distell's decision makers and Brand X was evaluated based on each of the prerequisites in the table. As Table 7.1 illustrates, Brand X complied with each of the prerequisites. This enabled the investigation to continue to the quantitative parameters.

Table 7.1: List of prerequisites for one-way glass bottles: Brand X's evaluation

No.	Prerequisites	Yes/No
I.	Is the target market for the product the South African mass market?	Yes
II.	Are the bottles that will be evaluated a product/SKU owned by Distell?	Yes
III.	Are the bottles' labels washable?	Yes
IV.	Are the bottles made of glass?	Yes
V.	Is the brand a RTD product?	Yes
VI.	Is it bottled locally for shorter return distance?	Yes

7.1.2 Excel evaluation input template

The data from the brand that is under consideration had to be entered into the DST. Figure 7.2 illustrates the user-friendly evaluation input template, which included all the data that were required to evaluate a brand's level of reusability.

Brand under consideration	Number of bottles sold in FY	Deposit per bottle (ZAR)	Average retail price per bottle (ZAR)	Average COGS	Average inventory value	Number of SKU's within brand
Example brand	*1 365 894*	*R 1.54*	*R 28.58*	*R 25 839 574*	*R 18 570 285*	*2*
Brand X	**1 065 987**	**R 1.54**	**R 35.24**	**R 13 996 587**	**R 3 437 720**	**1**
Colour legend: Good – Bad						

Figure 7.2: Excel evaluation input template: Brand X under consideration

As Figure 7.2 illustrates, Brand X performed well with its deposit per bottle and number of SKUs within brand. The number of bottles sold for the 2015 FY, average cost of goods sold for the 2015 FY and average inventory value for the 2015 FY were relatively average in performance. Only the average retail price per bottle was not performing well.

One shortcoming of the evaluation input template's colour format was that it did not provide sufficient information on the complete performance of the brand under consideration. After the data had been entered into the evaluation input template, it was transferred to the DST's parameters' input templates to provide a more thorough outcome on the brand under consideration. These quantitative input templates are discussed below.

7.1.3 Weight attribution

Before a brand's parameter outcome can be calculated in the output sheet, it should be multiplied with the weight attribution. The weight attribution from the decision makers indicates the importance of each identified parameter for evaluating the reusability of glass wine bottles. Table 7.2 illustrates the outcome of the decision makers' weight attribution with the average and converted average weighting of each parameter. It is interesting to note that the weighted average for most of the parameters was relatively high, between 68 and 100. Having parameters with high weightings from various departments within Distell indicated that the parameters deriving from literature and practice were relevant when relating to the reusability of glass wine bottles.

Table 7.2: Decision makers from various department's weight attribution for each parameter

	Department's weight attribution						
Parameter	**Marketing**	**Business Improvement**	**Distribution (1)**	**Other**	**Distribution (2)**	**Average**	**Converted Average**
Return rate	5	5	5	5	5	5	100
Average retail price per bottle	5	4	4	4	4	4.2	84
Deposit as % of selling price	2	5	5	4	1	3.4	68
Number of bottles sold	5	4	4	5	4	4.4	88
Level of standardisation	0	5	5	5	5	4	80
Inventory turnover rate	4	3	5	4	5	4.2	84

From the table, it was clear that the return rate was regarded as the most important parameter for evaluating the reusability of glass wine bottles. This is evident since the decision makers' weight attribution for return rate has a full converted average of 100 as Table 7.2 illustrates. The return rate was also the only parameter with a converted average of 100 in the importance weighting input sheet.

The number of bottles sold, average retail price, inventory turnover rate and level of standardisation all received a converted average weighting of between 80 and 88. This indicated that each of these parameters were relatively important to the decision makers of Distell when evaluating the reusability of glass wine bottles. The deposit as a percentage of selling price gained the lowest converted average weighting of 68, meaning that it was not deemed as important when evaluating the reusability of glass wine bottles.

7.1.4 Return rate

The first quantitative parameter being discussed is the return rate, which was regarded as one of the most important indicators for evaluating the reusability of glass wine bottles. Even though no data were available on Brand X's return rate due to it being a non-reusable brand, the return rate provided insight into which of the reusable brands are performing the best. The researcher would suggest that there should be some correlations between the brands with the highest level of reusability and highest return rates. This statement shall be confirmed or rejected in Section 7.2.3 of this chapter. The outcome of the parameter is illustrated in Figure 7.3.

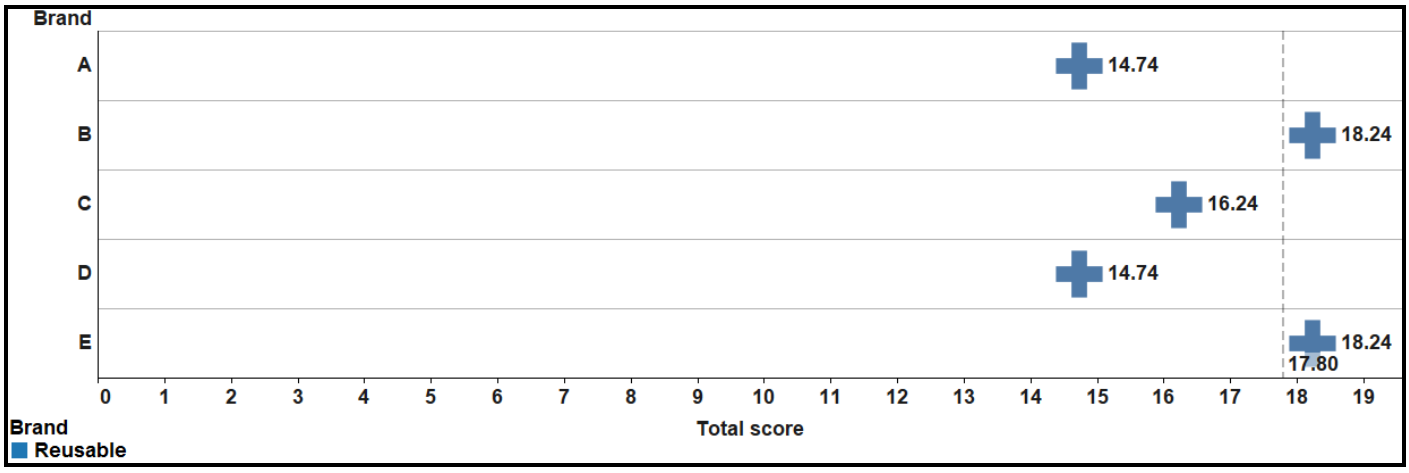


Figure 7.3: Total score for return rate per wine brand

The total scores for Brands A to E range from 14.74 to 18.24. An addition to this parameter, Distell's minimum required return rate is 80%. When the minimum required return rate of 80% is entered into the DST, the outcome is 17.8 as indicated by the dashed line[3]. Only two of the brands, Brand B and Brand E, fulfilled this requirement as Figure 7.3 illustrates. Brand C was merely 1.56 points below the requirement, while Brands A and D fell far behind with a total score of 14.74 each.

Even though Brands A and D were far below the minimum required 17.8 points, they were still being reused. According to Van den Berg (2017), even though the brands are below the 80% minimum required return rate, they are being reused because they are the right type of SKU for reusable glass wine bottles. The right SKU is one that complies with the list of pre-requisites. Distell is also making incremental changes, like supplying crates for used bottles to increase these brands' overall level of reusability.

Having wine brands with a low return rate that are still being reused might provide an opportunity for a non-reusable brand, like Brand X, to be introduced to the reusable bottle market where it

[3] The same minimum requirement for return rate is also applicable to Distell's ciders, RTDs and spirits bottles.

might start off with a low return rate and with incremental changes, gain a higher return rate. However, in order to draw a better conclusion, one also has to look at the other quantitative parameters. The next parameter is the average retail price.

7.1.5 Average retail price per bottle

The average retail price per bottle indicates the value a consumer receives for the money they spend. The mass market that is responsible for most of the returned bottles are price sensitive, making this parameter an important component of the DST as confirmed by the weight attribution discussed earlier in Section 7.1.3.

Figure 7.4 illustrates that Brand X had the lowest score when its average retail price was compared to that of the reusable bottles. Even though Brand X had the lowest score, it was not too distant from the total scores of the reusable bottles, scoring only 0.86 points lower than that of Brand A.

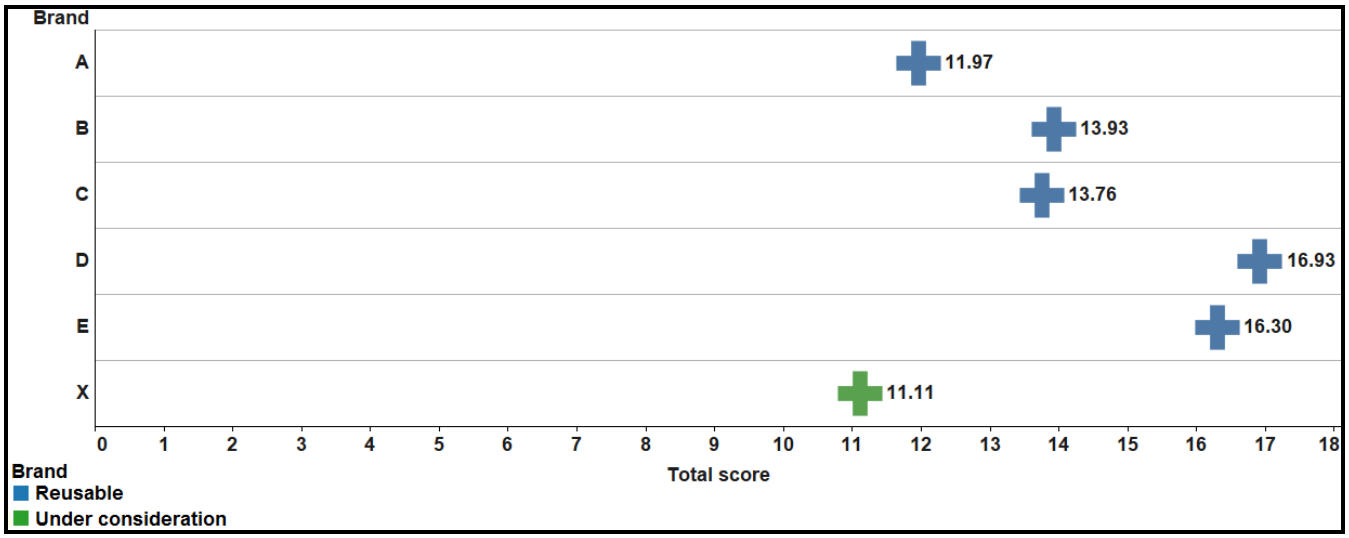


Figure 7.4: Total score for average retail price per wine brand: Brand X under consideration

To increase Brand X's total score, it can keep its selling price uniform over time until inflation increases the cost of the other reusable bottles. However, Distell still has to make a profit and a uniform price can put Brand X's profitability under strain even though a more competitive price can allow more sales and returns.

7.1.6 Deposit as a percentage of selling price

The deposit as a percentage of selling price provides an indication of the likelihood that a bottle will be returned by the consumer. This parameter gained the lowest converted average weighting out of all the parameters. It was interesting to note that the two weights provided by the decision makers working in distribution were completely conflicting with one attributing the lowest weight of 1 and the other the highest weight of 5 to the parameter as shown in Section 7.1.3.

This might indicate that Distell's personnel were uncertain of the relevance of this parameter to evaluate the reusability of glass wine bottles. Since the information on the weight attribution was gained through an online survey, the parameters were not discussed with them in person. An opportunity did exist to e-mail the researcher if there were any confusion on the parameters. However, no enquiries were received from the decision makers.

As with the return rate discussed earlier, this parameter also had a minimum required total score. The minimum required deposit as a percentage of selling price is 3% as set by Distell. When the 3% is calculated into the DST, it was 5.66 points as indicated by the dashed line in Figure 7.5. The monetary deposit on the returned wine bottles were the same regardless of which brand's bottle is returned. Therefore, the more expensive the retail price of the bottle, the lower the score for the brand. Brand X had the lowest score when it was compared to the other reusable brands. It was not significantly far from Brand A, which outperformed Brand X by 0.63 points. Even though Brand X had the lowest total score, it was still well within Distell's minimum requirement of 5.66 points.

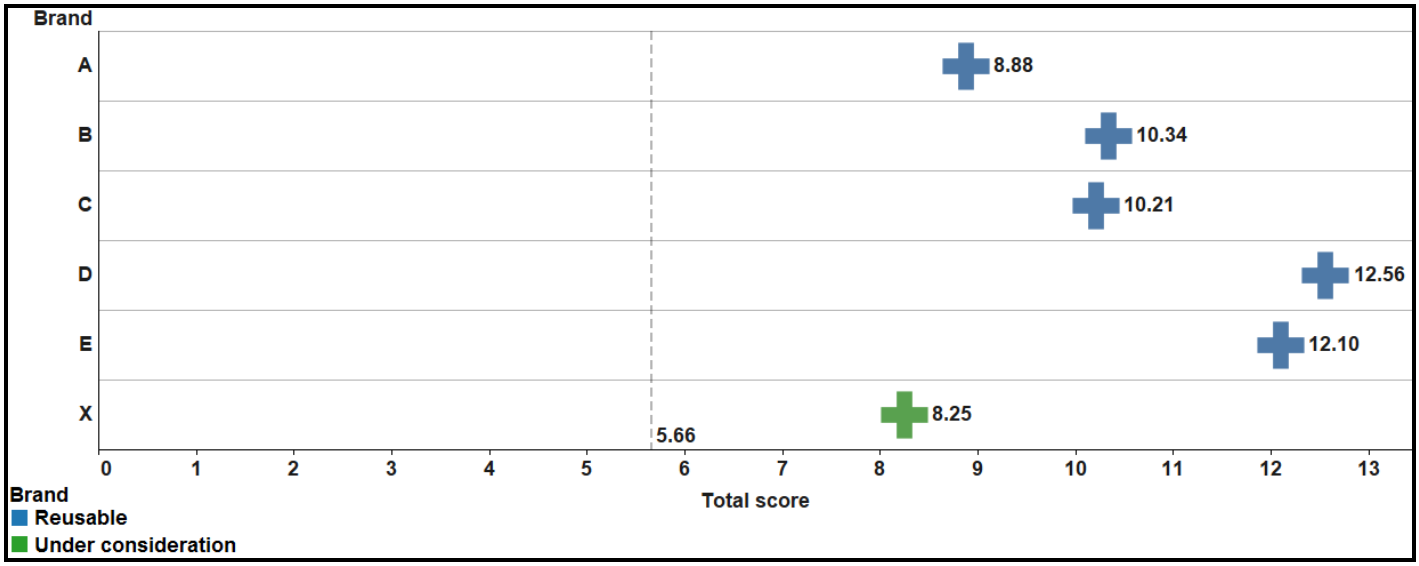


Figure 7.5: Total score for deposit as a percentage of selling price: Brand X under consideration

The outcome of this parameter can be misleading when determining whether bottles can be reused when it is only based on the minimum required total score. When the deposit as a percentage of selling price from other non-reusable brands (Brands F to I) was evaluated, only one of the non-returnable brands fell below the minimum required score. This proved that the minimum required score is not a trustworthy indicator of whether a brand is reusable. However, Distell's decision makers gave the deposit as a percentage of selling price the lowest weight attribution and therefore it restricted the overall impact that the parameter could have on the DST's outcome.

7.1.7 Number of bottles sold

The number of bottles sold parameter indicated the number of bottles of each brand that was sold for the 2015 FY. The more bottles a brand has in circulation, the more the company benefits from the economies of scale that accommodates it. According to the weight attribution from the decision makers, this parameter was also considered as important since it received the second highest converted average of 88 as shown in Section 7.1.3.

When comparing the total scores of the reusable wine bottles and Brand X, Figure 7.6 illustrates that Brand E undoubtedly had the most number of bottles sold for the 2015 FY. Brand E had more than 9 times as much sales as the average number of sales from the other reusable wine bottles, including Brand X. This was a large contribution to Brand E's level of reusability, which is reflected in the output template section of this Chapter.

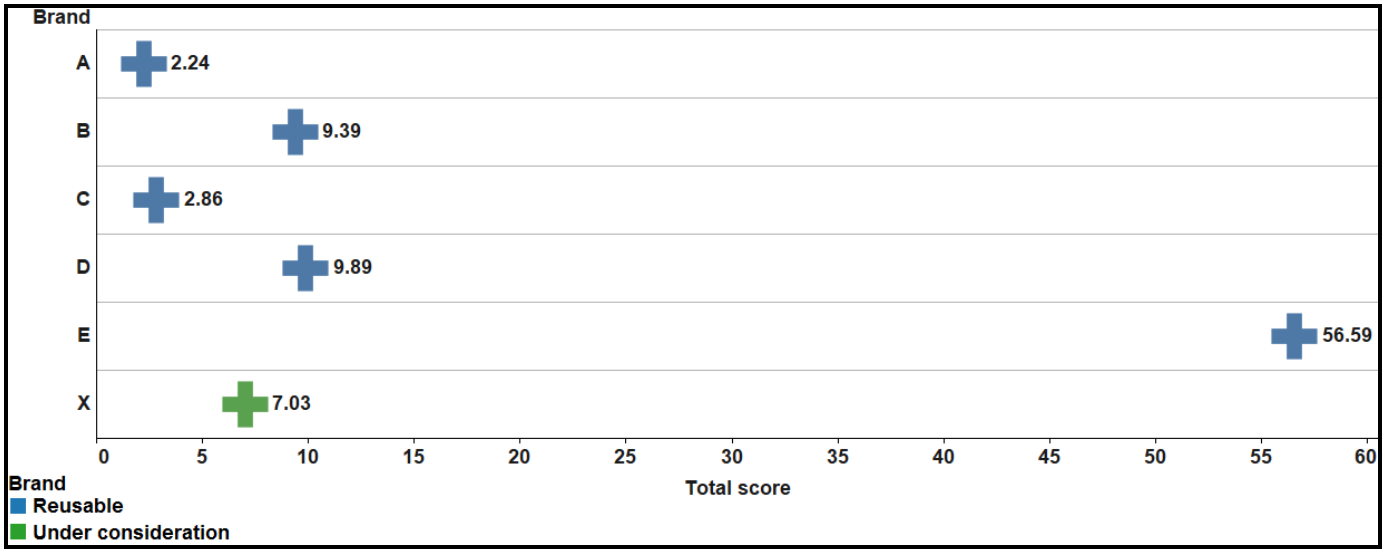


Figure 7.6: Total score for number of bottles sold for the 2015 FY per wine brand: Brand X under consideration

When Brand X's total score was compared to the other reusable bottles, excluding Brand E (due to its exceptionally high total score), it proved to be highly competitive. It outperformed Brands A and C by 4.79 and 4.17 points respectively. Having sales outperforming two other reusable brands was greatly favourable for Brand X when it was considered for becoming a reusable brand. Brand X's high sales volumes was also one of the initial reasons for the case company to consider reusing the Brand's bottles as discussed earlier in Chapter 5.

An additional consideration was to study the historical sales pattern of all the reusable and non-reusable brands to provide a better perspective on the number of bottles sold for the 2015 FY rather than viewing the sales of only one year. Doing this provided insight to whether a Brand's sales are rising, falling or unfluctuating. The number of bottles sold for the five years leading up to the 2015 FY was not included in the DST. However, it is important to assess the trends in order to assist the decision makers in making an informed decision when considering reusing Brand X.

Figure 7.7 provides the sales history of all the reusable and non-reusable brands for the 2011 to 2015 FY.

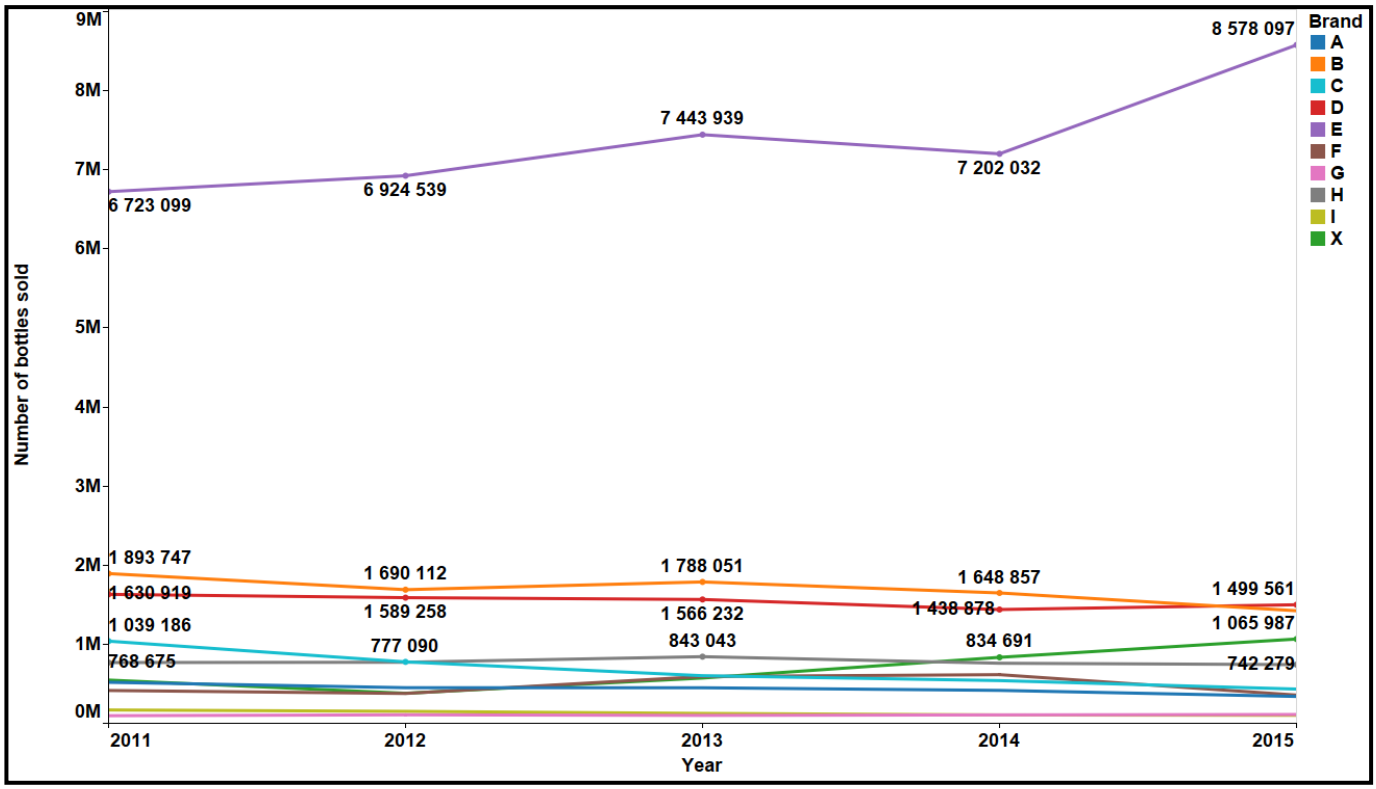


Figure 7.7: Number of bottles sold per wine brand from the 2011 until 2015 financial year

At first, it appeared that Brand E was by far the best performing brand by having large sales volumes that were clearly increasing while the rest of the brands appeared to have stable sales levels for each of the respective years. However, to draw a better conclusion, Figure 7.8 was created where Brand E is excluded in order to focus on the other reusable and non-reusable brands.

Figure 7.8 indicates the difference in annual sales in more detail. When considering the 5-year average difference in the number of bottles sold from the year 2011 to 2015, the brands that have declined most are Brand A (-10%), Brand B (-7%), Brand C (-19%) and I (-12%) while Brand D (-2%), Brand F (+2%) G (+4%) and Brand H (-1%) have stayed relatively constant. Brand E and Brand X have shown the highest increase in sales over the five year period, with a 7% and 23% increase respectively.

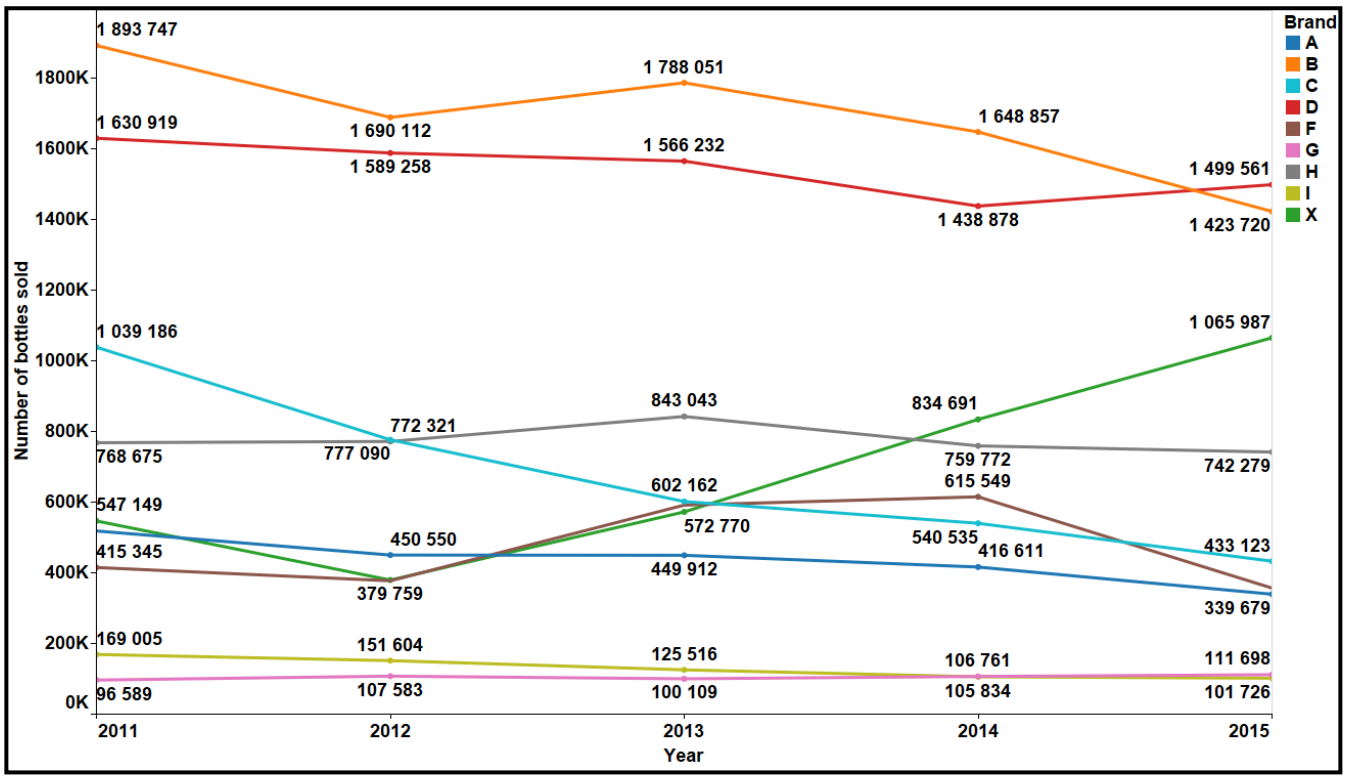


Figure 7.8: Number of bottles sold per wine brand (excluding Brand E) from the 2011 until 2015 financial year

When only Brand X's number of bottles sold were highlighted from all the other Brands in Figure 7.9, it was clear that Brand X had the highest annual sales increase. At the time of writing this, the number of sales for Brand X for the year 2016 had been released and they indicated an increase in sales of 45% from the year 2015 to 2016. This illustrates that Brand X is becoming increasingly popular among the mass market consumers (Mettyear, 2015:5, 2016) while Distell's Integrated Company Reports (2015: 11, 33; Distell Group ltd., 2016a) suggest that the growth momentum will continue.

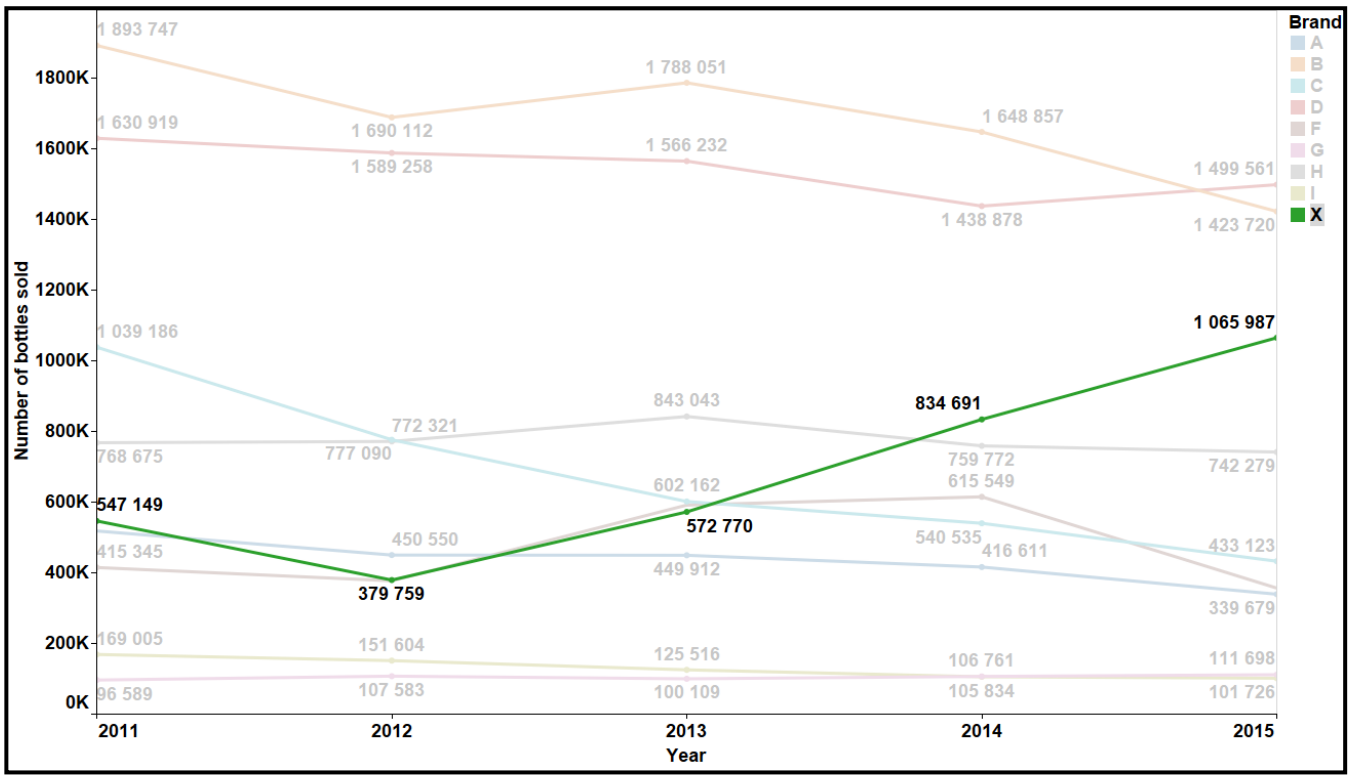


Figure 7.9: Number of bottles sold per wine brand (excluding Brand E) from the 2011 until 2015 financial year. Brand X's sales figures are highlighted

Having this large number of bottles sold along with the growth momentum discussed above increased Brand X's level of reusability. However, since Brand X was not being reused at the time of writing, one has to consider that all of Brand X's bottles that were sold were discarded. This includes discarding the empty glass wine bottles to landfills, which has a negative environmental impact, or by recycling. Recycling the empty glass bottles does have a smaller environmental impact than discarding it to landfills. However, reusing the bottles will have the least negative effect on the environment in comparison to recycling and discarding to landfills (Stock, 1998; Jayaraman *et al.*, 2008) as discussed earlier in Section 3.1.

7.1.8 Level of standardisation

The level of standardisation parameter indicates the number of bottle types that are trading within a brand. The higher the number of bottle types a brand has in circulation, the lower the level of standardisation of that bottle. The more standardised the bottles types trading within a brand, the more the owning company will benefit, with less labour required to sort the recovered bottles, longer production runs and less inventory cost due to inventory pooling (Ko *et al.*, 2012).

When considering the weight attribution in Table 7.2, it was worth noting that the decision maker working in the marketing department was the only person that gave this parameter below a five by giving it a zero, meaning that it is not applicable. An interview with Marius Kotze (2016), a marketer from a South African upmarket wine company, suggested that marketing departments in companies are in general against using standardised bottles since it hinders their brand from

differentiating itself from the competitor's wine bottles. This could possibly explain the marketer's weight attribution.

The total scores for level of standardisation were not as diverse as the other parameters discussed earlier in this section, as Figure 7.10 illustrates. This was a result of the brands only having a positive integer figure of between one and three. The result was various brands having the same amount of SKUs trading within the brand and therefore deriving at the same total score as Figure 7.10 illustrates.

Brand X along with all the other reusable brands have the same total score for the level of standardisation except for Brand E. Brand E has various bottle types trading within its brand, resulting in more bottles that have to be sorted and shorter production runs because of different bottle types that must be set up for each production run. Brand E also does not benefit by pooling bottles together resulting in larger overhead costs.

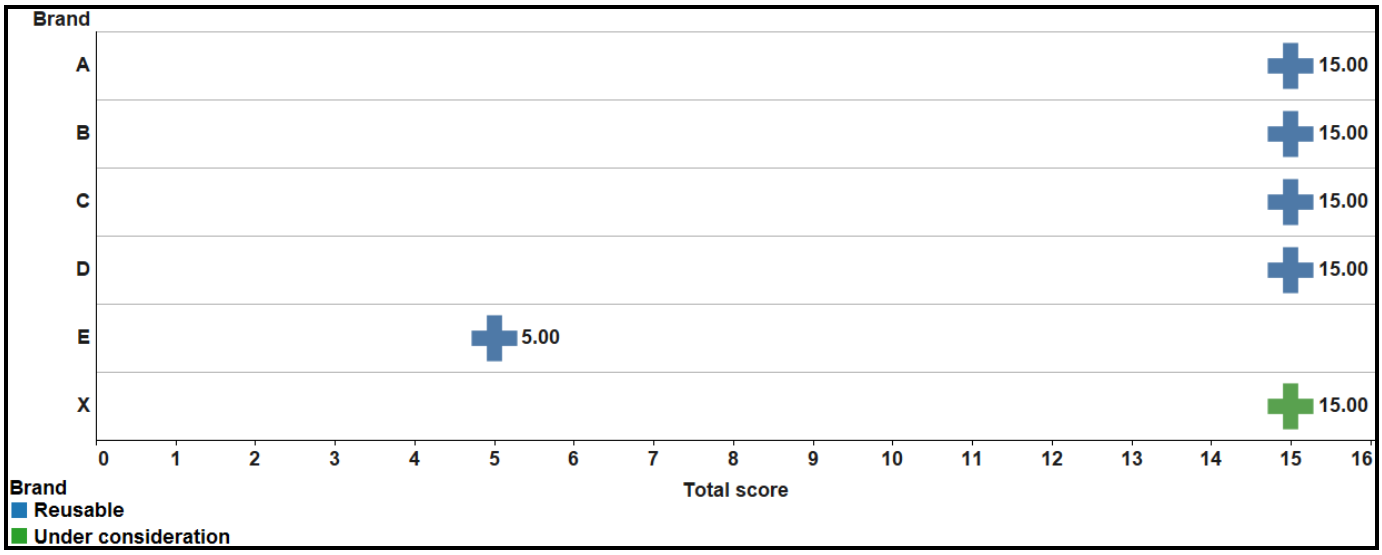


Figure 7.10: Total score for level of standardisation per wine brand. Brand X under consideration

7.1.9 Inventory turnover rate

The inventory turnover rate parameter focuses on the production performance of a product by illustrating the amount of inventory that is being sold over a given period of time (Demeter & Matyusz, 2011:156). As Figure 7.11 illustrates, Brand X did not perform that well in comparison with the other reusable brands by only outperforming Brand C. The reusable brands have an average score of 14.00, which was more than double that of Brand X's 6.26 points.

Brand X can increase its inventory turnover rate by lowering inventory levels or increasing sales. For the 2015 FY, Brand X had 4.81 times more inventory than Brand B, which had a similar amount of cost of goods sold. Therefore, better inventory management is required. It should also be noted that Brand X had experienced large increases in annual sales, which is expected to

continue, thus providing opportunity to increase its inventory turnover rate in the years to follow, should the increase in sales continue.

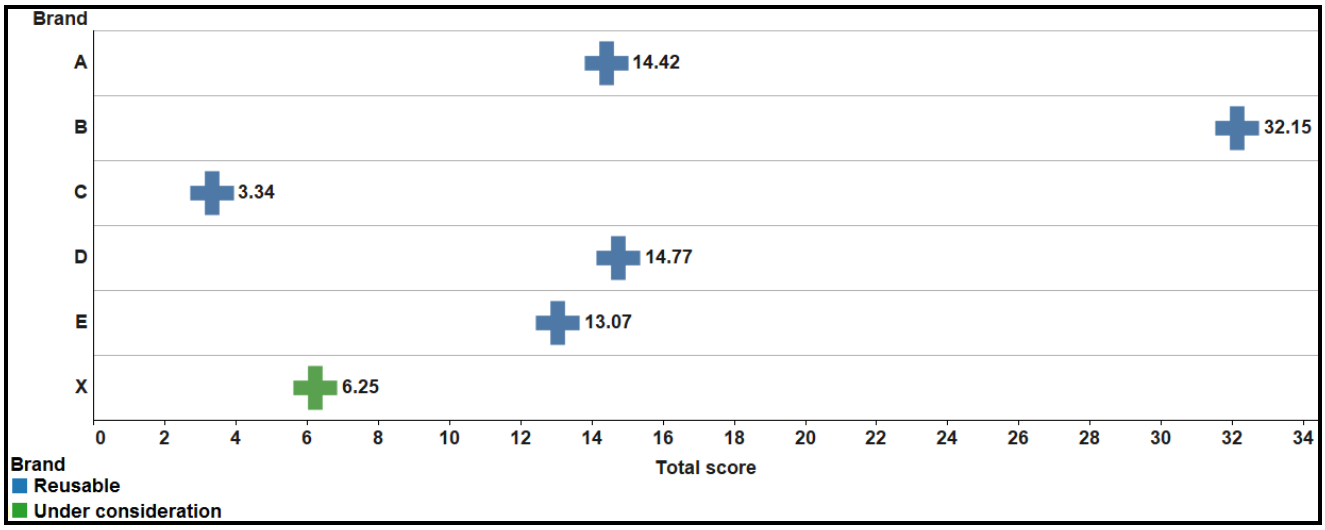


Figure 7.11: Total score for inventory turnover rate. Brand X under consideration

7.1.10 Estimated returns per region

The estimated returns per region, like the 5-year history of the number of bottles sold, is an additional consideration parameter that is not included in the DST's model component. This parameter acted as a rational check to indicate whether Brand X's bottles were sold in significant numbers in geographical areas in South Africa where the return rates are considered high. The calculations for this parameter are explained in Section 6.2.2.1, while the results are shown in Table 7.3.

Table 7.3: Excel spreadsheet of estimated returns per region parameter calculations

Region	Coastal	Central & Northern	South	Total
Total number of reusable wine bottles sold 2015 (FY)	1 736 883	8 082 608	2 454 691	**12 274 181**
Total number of reusable wine bottles recovered 2015 (FY)	1 245 103	6 565 322	1 182 460	**8 992 885**
Return rate per region 2015 (FY)	72%	80%	48%	
Number of Brand X bottles sold 2015 (FY)	169 647	665 358	230 981	**1 065 987**
Estimated returns of Brand X bottles 2015 (FY)	121 614	549 981	111 267	**782 861**
Brand X estimated return rate 2015 (FY)				**73%**

Table 7.3 indicates that the Central, Northern and Coastal regions of South Africa had the highest return rate for reusable wine bottles, with return rates of 80% and 72% respectively. The Southern region had a low return rate of 48% in comparison to the other regions. Figure 7.12 illustrated a heat map with the three main regions shaded in green according to the return rates. A higher return rate results in a darker shading.

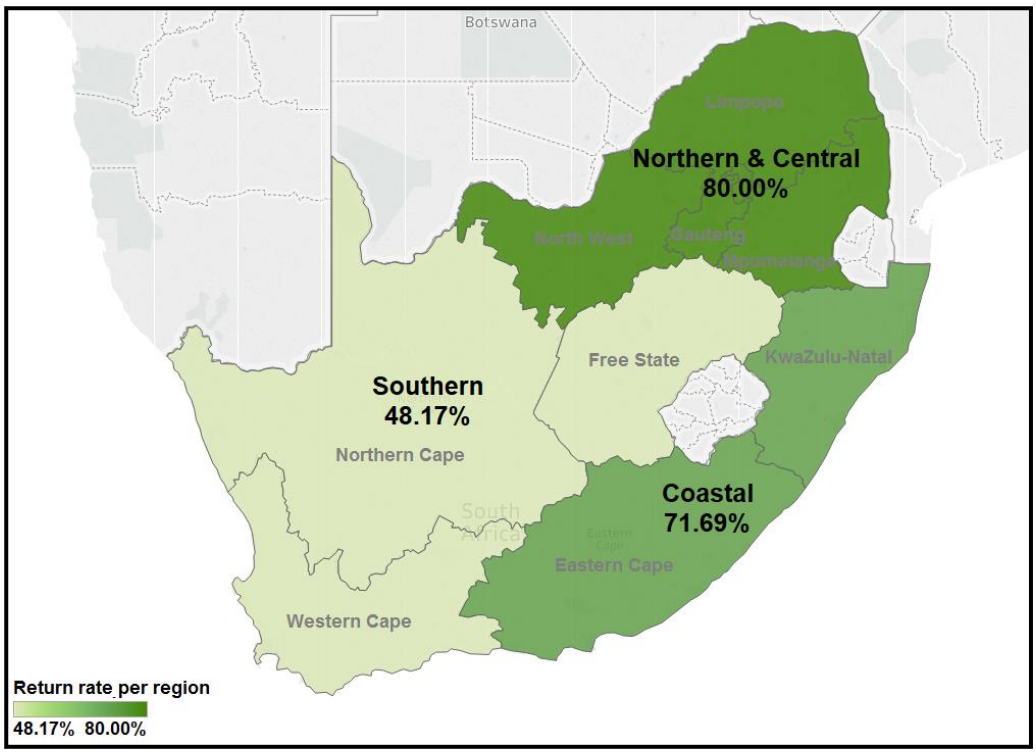


Figure 7.12: Return rate of reusable wine bottles per region in South Africa

Brand X's results from Table 7.3 were also charted on a heat map in Figure 7.13. Brand X had the largest sales in the Northern and Central region, with 665 358 bottles sold. The Southern region was second highest with 230 981 bottles sold and the Coastal region had sales of 169 647 bottles.

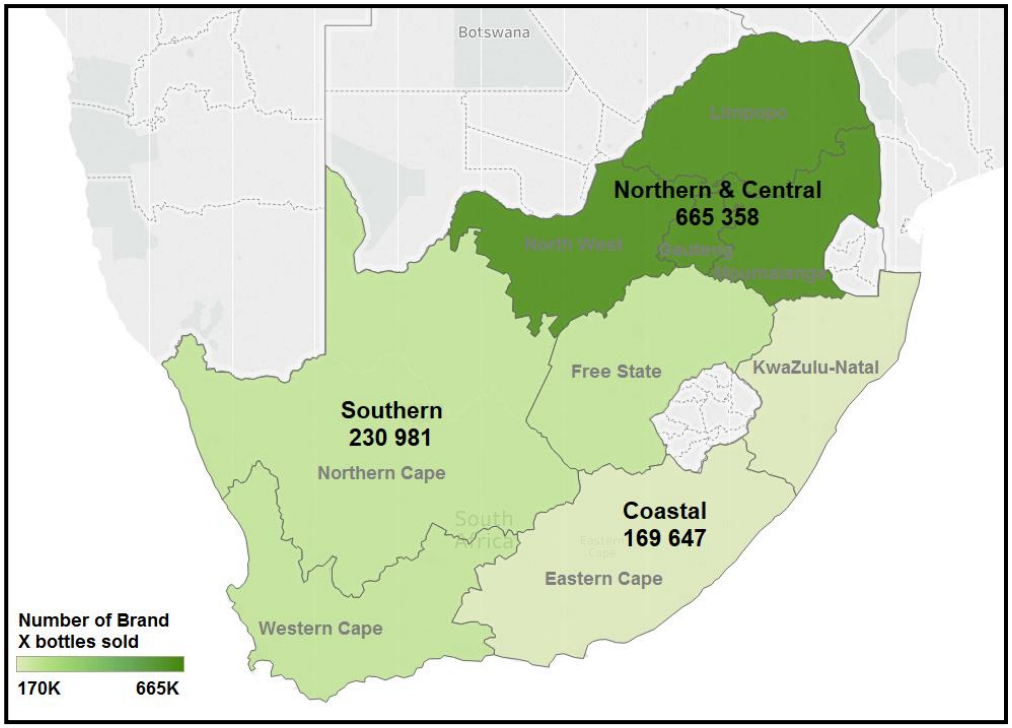


Figure 7.13: Total number of Brand X wine bottles sold per region in South Africa

When comparing these two heat maps it is clear that there is an alignment with the large number of Brand X's bottles sold and the high return rate of the Northern and Central region. However, this is not the case in the Southern and Coastal regions. The Southern region had 1.3 times more sales than the Coastal region, while having 23.5% lower returns. This created concern for the large number of bottles in the Southern region that would be sold and not be returned for reusing.

When focusing on Brand X's sales and return rate on a national level, the results are less concerning. When the number of Brand X sales per region is multiplied by the return rate for the same region and added up, the estimated return rate for Brand X on a national level is equal to 73%. The 73% national return rate should not be taken literally, since there are a large number of complex factors that should still be taken into consideration. The figure does, however, indicate that Brand X has significant sales in the regions where the returns are high.

A last concern with regard to the geographical regions in which Brand X is sold, is the large distance between the Northern and Central region and the Western and Eastern Cape provinces. All of Distell's wine bottles are filled in Port Elizabeth in the Eastern Cape or in Green Park in the Western Cape (Distell, 2015:161). Having such a long haul from the Northern and Central regions to these two locations increases overhead costs of recovering and returning the wine bottles. However, one can argue that the large number of reusable bottles originating from these regions provides the necessary economies of scale that justifies the long return haul to be reused.

The estimated returns per region parameter provides a good indication of the alignment between Brand X's sales and the current return rates for returnable wine bottles for the areas in which it is sold. The parameter had various shortcomings due to the lack of more specific data to indicate whether the sales and return rates in smaller areas within the regions also align. Working with this data could provide a more valid and reliable outcome on this parameter.

7.2 Output template

The output template of the DST is the platform where all the outcomes from the parameters' input sheets are linked. The output template is also the platform where the final calculations were done to derive at a brand's level of reusability. In this subsection, the structure of the output template is discussed along with the level of reusability of the reusable brands and the reusability of Brand X in comparison to the reusable wine brands.

7.2.1 Output template structure

To recapitulate from Chapter 6, Table 7.4 illustrates an example of the output sheet of one brand, Brand A. The output sheet contains the weight attribution from each parameter along with the brand's score deriving from the parameter's input sheet. The 'total score' is calculated by multiplying the weight with the parameter's score. Two levels of reusability are calculated by

adding up the total scores. The two outcomes of the DST are the 'level of reusability' where all the total scores are added up and the second is the 'level of reusability excluding return rate' where all the total scores are added up and the return rate parameter's total score is excluded. The difference between the two levels of reusability is explained in Section 6.2.2.2.

Table 7.4: Output template for one brand with parameter, weight attribution and total score

Brand	Parameter	Weight	Score	Total score
A	Return rate	100	0.15	14.74
A	Average retail price per bottle	84	0.14	11.97
A	Deposit as % of selling price	68	0.13	8.88
A	Number of bottles sold	88	0.03	2.24
A	Level of standardisation	80	0.19	15.00
A	Inventory turnover rate	84	0.17	14.42
A	**Level of reusability**			**67.25**
A	**Level of reusability excluding return rate**			**52.51**

7.2.2 Reusable brand's level of reusability

Comparing the reusable brands' level of reusability provided a good indication of which of the brands was performing best when all the parameters were brought into calculation. The information from the output template was exported to the user-interface component to simplify the interpretation of the outcomes. Figure 7.14 illustrates the level of reusability for all the reusable brands.

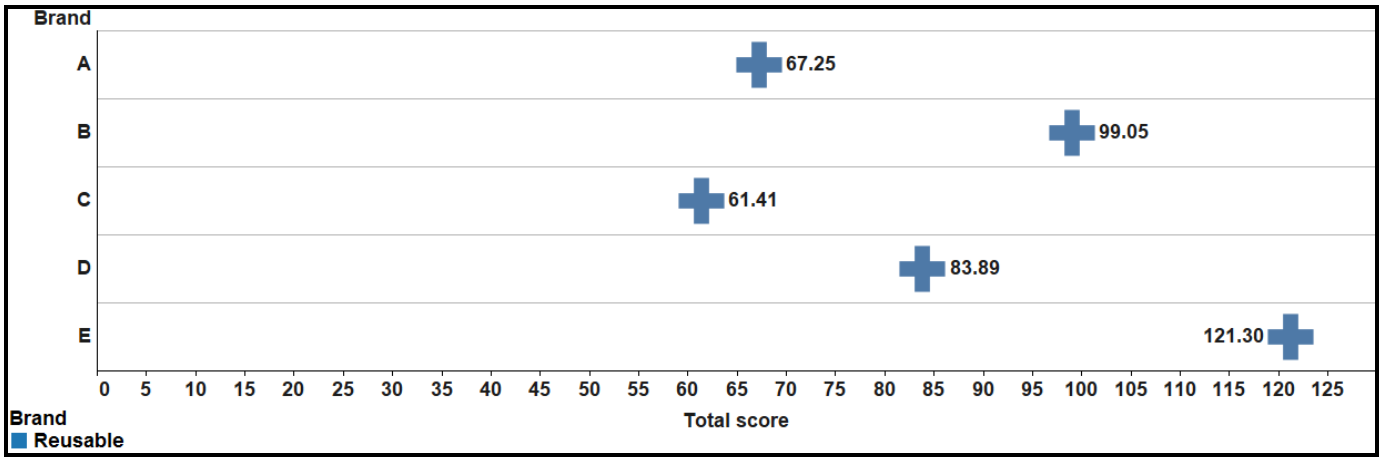


Figure 7.14: Level of reusability per brand

As the figure clearly shows, Brand E has the highest level of reusability when compared to all the reusable wine bottles. This is primarily because of the brand's large number of bottles sold. Brand E also had good scores with its return rate, retail price and deposit as a percentage of selling price. Even though Brand E had the lowest total score for level of standardisation, it still proved to be the most reusable glass wine bottle based on the outcome of the DST.

The second most reusable bottle that the company has in circulation is Brand B. This was largely due to the brand having the highest score for inventory turnover rate and return rate. Brand B's scores for the other parameters were in general on par with the other reusable bottles' parameters, thus resulting in a high level of reusability.

Brand D, with 83.89, has the third highest level of reusability, placing it just below the average level of reusability of 86.58 points. The largest contributor to the brand's level of reusability was its number of bottles sold, retail price and deposit as a percentage of selling price. One shortcoming of Brand D is that it had one of the lowest scores for return rate, which was considered as one of the most important parameters.

Brand A proved to be the fourth most reusable brand. According to the outcome from the parameters, Brand A had the lowest score for its return rate, average retail price, deposit as a percentage of selling price and number of bottles sold. Its level of standardisation and inventory turnover rate was on par with most of the other brands.

Brand C is the brand least suitable to be reused according to its level of reusability deriving from the DST. This was because the brand had the lowest score for its inventory turnover rate and the second lowest score for number of bottles sold. Brand C had a below average score when its average retail price, deposit as a percentage of selling price and level of standardisation were compared to the other reusable brands. The result of being outperformed by most of its parameters and having the just below average scores for the rest of its parameters was that Brand C was regarded as the least reusable wine brand owned by Distell from a business logistics perspective.

The following subsection is one of the most important sections. The outcome of Brand X's level of reusability is compared to the reusable brands to provide an answer to the research question. Other non-reusable brands were also evaluated to verify the validity of the DST.

7.2.3 Reusable brands' and Brand X's level of reusability

The research question asked under which business logistics circumstances it would be viable to implement reusable wine bottles. The DST was developed to derive at a viable and quantifiable outcome based on the research question. The outcome is discussed in this section. The results are illustrated in Figure 7.15. As previously stated, the level of reusability where non-reusable and reusable bottles are compared to one another required the return rate's total score to be excluded.

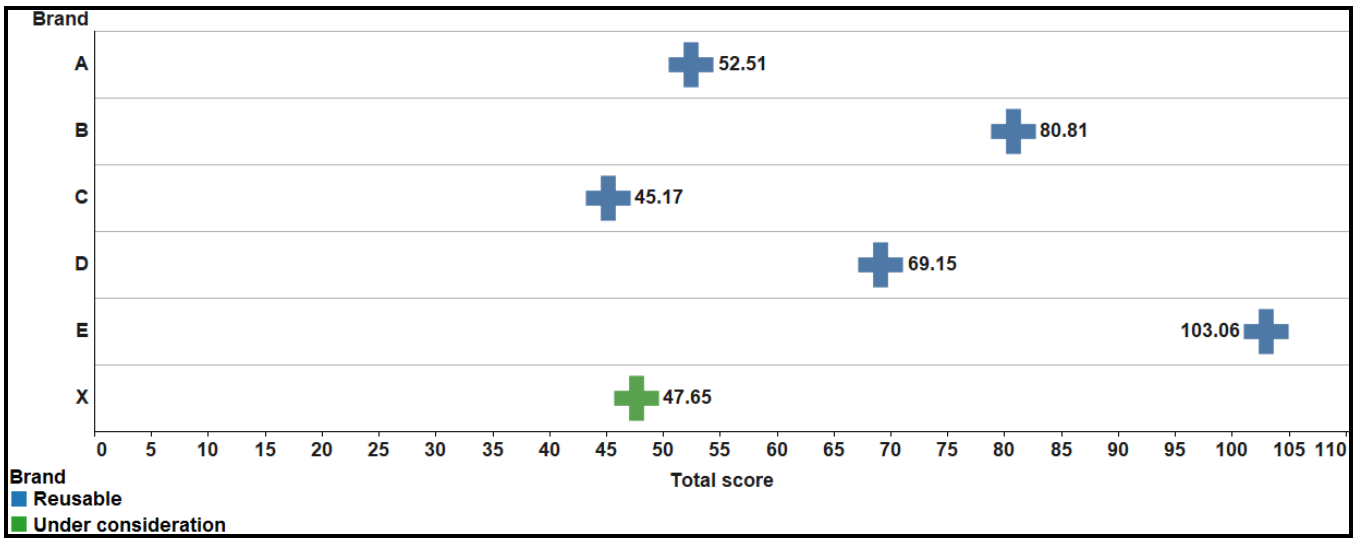


Figure 7.15: Level of reusability for reusable and non-reusable brands. Brand X under consideration

As Figure 7.15 illustrates, Brand X's level of reusability was relatively low when compared to the other reusable brands' level of reusability. Brand X did have a higher level of reusability in comparison to Brand C and was within range of Brand A's level of reusability. When Brand X's parameters were compared to the reusable brands, it had the third largest number of bottles sold while its level of standardisation was on par with the other reusable brands. Parameters that had to change in order to improve its level of reusability were its average retail price, deposit as a percentage of selling price and its inventory turnover rate.

Since the DST requires quantitative information, one can calculate the extent to which each parameter has to improve to provide the brand under consideration with the best possible level of reusability. Doing this assisted the researcher to answer the research question and identify the business logistics circumstances under which it would be viable to implement reusable wine bottles. From the parameter input sheets, it is calculated that if Brand X decreases its average inventory by 70%, which is the average value of inventory for brands with similar sales, it will have a higher level of reusability than Brand A and Brand C as illustrated in Figure 7.16 by the light green cross. This will place Brand X within range of the other reusable brands' level of reusability.

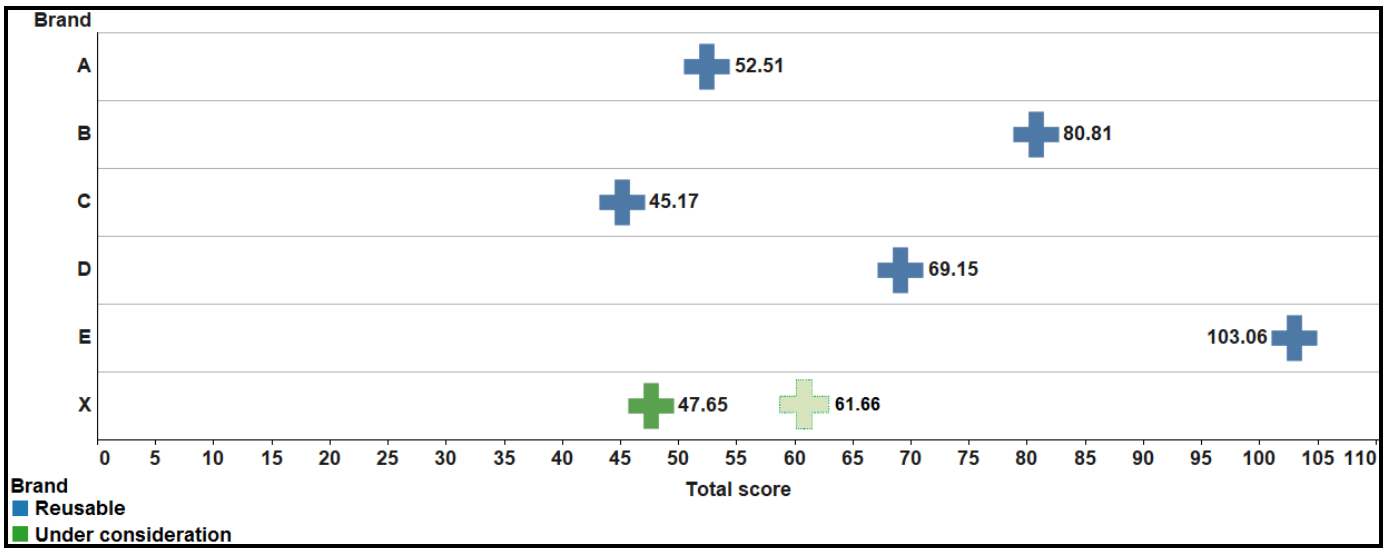


Figure 7.16: Level of reusability for reusable and non-reusable brands. Increase in Brand X's level of reusability due a 70% decrease in average inventory represented by light green cross

Another parameter that can increase Brand X's level of reusability is its retail price. If, for example, Brand X wants to have a higher score than Brand A and Brand C, it would have to reduce its retail price by 32% as illustrated in Figure 7.17 by the light green cross. However, a decrease in price is highly unlikely to happen in practice in comparison to better inventory management with regard to average inventory value for 2015. The sales figures of Brand X are also increasing at a high rate, which can increase the cost of goods sold for the following year, which will lead to an increase in the Brand's inventory turnover rate.

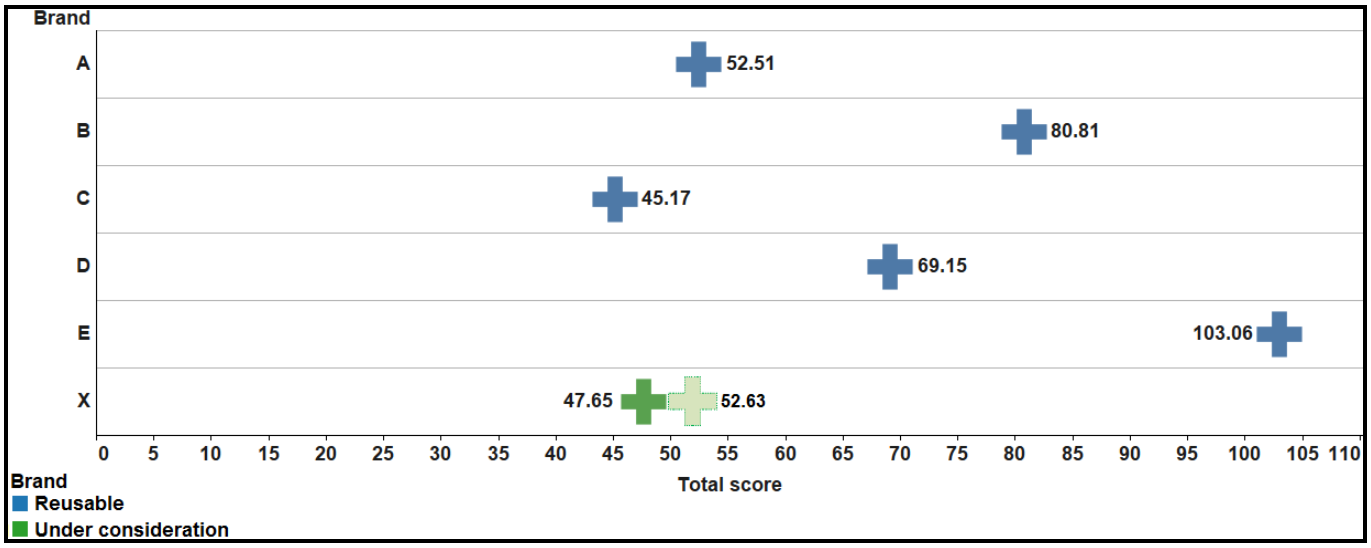


Figure 7.17: Level of Brand X's reusability in the event of a 32% decrease in retail price

In summary, the researcher expected the DST's outcome to conclude that Brand X is to an extent reusable from a business logistics perspective. This conclusion is explained by Brand X's high number of bottles sold, annual increase in sales and Brand X being sold in a standardised bottle. The other parameters of Brand X, which include turnover rate, average retail price and deposit as a percentage of selling price, have to improve to provide a more confident outcome with regard to Brand X's level of reusability.

The researcher also expected a good correlation between all the reusable brands' return rate parameter and level of reusability. This expectation resulted from the great importance attached to the return rate parameter for evaluating the reusability of brands. The correlation was evident when comparing the return rate outcome for reusable bottles in Figure 7.3 and the level of reusability per brand in Figure 7.14 to one another. In the following section, the DST was evaluated based on its model and data component and the findings from this research.

7.3 DST evaluation

The findings that the DST delivered should be evaluated based on its validity and reliability to evaluate the reusability of glass wine bottles. The model and the data component are individually evaluated along with the findings of the DST.

7.3.1 Model component

An important part of ensuring the validity and reliability of the DST required the frameworks set out by Sauter (2011:321) and Tennant and Friend (2005:32–33) to be strictly followed and documented. This was done in Chapter 6 of this research paper in order to improve the replicability of the DST and to ensure that it can be applied to other similar cases.

The physical construction of the DST in Microsoft Excel was based on Tennant and Friend's (2005:32) six-step business modelling process discussed in Section 4.3. The process focused on setting up the output and input templates, populating the input templates, creating a working page for the main sections, transferring the results to the output pages, testing and debugging the DST and finally developing the user interfaces and conducting user testing. After these guidelines were strictly followed, the DST was developed and functioned as planned.

Sauter's (2011:321) four design stages were also strictly followed in parallel with Tennant and Friend's (2005) development process. These stages included the initial analysis where Distell's key decisions and decision needs were identified. It also required a situation analysis, which focused on the company setting. This was addressed in the Chapter 5. The third stage required the system design, which was primarily addressed by Tennant and Friend's (2005) development process. Finally, the implementation required the DST to be deployed and demonstrated to the decision maker to validate the complete tool and its findings. The decision makers' findings are discussed in Section 7.3.3.

7.3.2 Data component

Sauter's (2011:73) 12 characteristics of useful information was followed as discussed in Section 4.4.2 to ensure the validity and reliability of the data. The data complied with all of the characteristics. However, there were concerns about the timeliness of the data. The concern is

based on the quantitative data that were acquired ranging from the 2011 to 2015 financial year. The study commenced in the year 2016. Therefore, the most recent complete year at the time of requesting the data was the 2015 financial year. This has an effect on the outcome's meaningfulness to the user.

Fortunately, the user-friendliness of the DST allows swift changes to be made in the input templates to update the DST. Even though the latest data can easily be requested and entered into the DST, it will take too long to collect the required data inside the company to fall within the time scope of this research.

Sauter (2011) defines data as reliable when it is accurate, correct and verified. According to the contact person within Distell, the data found in this research were handed over to the researcher in the same format in which it was received from the various departments within Distell. The data were not tampered with to mask the information.

The qualitative data that were used within the DST primarily related to the prerequisites a one-way bottle must comply with to be evaluated for its level of reusability. Each of the prerequisites was discussed and approved by a decision maker that primarily works with the reuse of Distell's glass bottles. The only data that were adjusted were the original names of the reusable and non-reusable brands. Fortunately, this change did not affect the outcome of the research due to the brands' identity not being applicable.

7.3.3 Findings

The frameworks and findings of the DST were presented to the decision makers at Distell to be evaluated. The case company approved the outcome of the DST. However, they commented on the fact that this research only perceived the evaluation of reusing Brand X from a business logistics perspective. A comment from Van den Berg (2017) places this statement in perspective. He states that deciding whether a glass wine bottle is reusable in practice is difficult because of the overall complexity of a reuse system, and this decision cannot be made by relying only on one model.

Van den Berg (2017) stated that the DST of this research attempted to answer the question from a complicated systems approach, while it should be answering it from a complex systems approach. Complicated systems contain subsets of manageable variables that can be measured and controlled, such as flying an aeroplane. Complex systems consist of multiple complicated systems. They bear large elements of ambiguity and uncertainty, which is difficult to measure and manage like the economy of a country (Forest, Marchildon & McIntosh, 2004:24).

The DST of this research contains subsets of manageable variables in the form of the input parameters that can be measured and controlled to an extent, therefore placing it in line with the

complicated systems approach. In order to answer the question from a complex systems approach, more perspectives should be incorporated to provide an outcome on whether Brand X is viably reusable in practice. The additional perspectives are perceived as recommendations for future research.

The framework of the research was presented in the Excel input sheets and output sheets to illustrate how the calculations were made. The decision makers were satisfied with the setup and calculations of the model. They also saw the DST as being user-friendly due to the evaluation input template only requiring the essential data points of a brand to be entered to be evaluated with the DST. The cells of the evaluation input template are linked to the rest of the DST and can instantly provide an outcome on the brand being evaluated.

A last comment from the decision makers was that it would be interesting to see the outcome of a spirit's brand or a cider brand compared to the rest of the reusable wine brands. This is in line with Distell's decision requirements stating that the DST should be able to be reused on other products within Distell. Doing this would place the outcome of the reusable wine brands in the perspective of Distell's broader reusable brand catalogue. Entering data from Distell's other reusable cider or spirits brands into the DST can be easily done due to the user-friendliness of the DST and since the specific data that are required are established in this research. However, this was not done during the research since it exceeds the scope of this thesis.

Chapter 8 – Conclusions and Recommendations

8.1 Introduction

In the introductory chapter of the research, the research introduces the South African wine industry's contribution and dedication to environmental sustainability. One of the focus points of this research was to explore the opportunity for increasing the South African wine industry's contribution towards environmental sustainability. Reusing more glass wine bottles can potentially result in an increase of the wine industry's contribution to environmentally sustainable business on the post-production side. The aim of this research was to design and test of a DST to evaluate of the reusability of glass wine bottles within a South African context. This was done at the hand of a case study. By doing this, the business logistics circumstances under which it is viable to implement a reusable wine bottle could be identified.

This chapter concludes the research by summarising the findings, drawing conclusions, discussing the limitations and the recommendations for Distell, the wine industry and academic research. The chapter closes with concluding remarks from the researcher.

8.2 Summary of findings

The research question asked under which business logistics circumstances it would be viable to implement reusable wine bottles. The question was asked within the context of the South African wine industry and its contribution to environmental sustainable business. In order to provide an answer to the research question, a DST was developed.

The DST required data from various quantitative and qualitative parameters of Distell's reusable and non-reusable wine bottles to be entered into the tool, along with an importance weighting for each parameter. The qualitative parameters represented the rules, facts and procedures that all one-way brands must comply with to ensure that the brand's circumstances are aligned for being reused within the South African context. These qualitative parameters can be seen as a list of prerequisites that the brand must meet in order to be considered for reuse in South Africa. The prerequisites are as follows:

- The target market for the product must be the South African mass market.
- The bottles must be owned by Distell.
- The labels on the bottles must come off during washing.
- The bottles must be made of glass.
- The brand must be a RTD product.
- Bottling of the wine must take place within South Africa.

When a one-way brand complies with each of the qualitative parameters, further evaluation can be done on its quantitative parameters. The quantitative parameters that are required to evaluate the reusability of glass wine bottles from a business logistics perspective were identified from studying literature and conducting interviews with Distell's key personnel. The following seven quantitative parameters were identified:

- Return rate
- Average retail price per bottle
- Deposit as % of selling price
- Number of bottles sold
- Level of standardisation
- Inventory turnover rate
- Estimated returns per region

Entering all the required data into the tool allowed the parameters of various reusable wine brands to be compared to that of a non-reusable wine brand to derive at a quantifiable outcome. The DST's outcome indicated whether the non-reusable wine brand being evaluated is viably reusable from a business logistics perspective.

A non-reusable wine brand, Brand X, was tested with the DST and the results indicated that Brand X was relatively reusable from a business logistics perspective. The DST's outcome also indicated that lowering Brand X's inventory levels could lead to a significant increase in Brand X's overall level of reusability. The required changes in the parameters represent the business logistics circumstances under which it is viable to implement reusable wine bottles.

The outcome of the research was a valid and reliable DST for evaluating the reusability of glass wine bottles. Distell's decision makers evaluated the outcome of the DST at the end of the research and validated the outcome as reliable. However, they stated that more research from different perspectives such as an economic, environmental and optimisation perspective were required before a final decision can be made to reuse Brand X in practice.

8.3 Conclusions

The research question required the identification of the business logistics circumstances in which it would viable to implement reusable wine bottles. This was done through the development of a valid and reliable DST. The business logistics circumstances were determined by Distell's reusable wine brands. After testing the DST on one of Distell's non-reusable brands, Brand X, the tool provided an outcome on the brand's level of reusability and highlighted the business logistics circumstances that were required for Brand X to be viably reusable.

The tool suggested that Brand X's inventory levels should be reduced along with its selling price to be viably reusable and on par with Distell's wine brands that are currently being reused. Therefore, Brand X requires a more competitive price and better inventory control to be viably reusable from a business logistics perspective.

The research also proved that it was able to translate information deriving from a 'real-life' problem into an academic framework called a DST to address a research question. The framework was able to process the information and it provided a valid and reliable outcome that can be used by managers to make important and informed decisions in 'real-life' scenarios.

The result of the DST could be used to determine guideline values that a company or alliance of companies should consider when evaluating whether their products are reusable. Since the values of the reusable brands' quantitative parameters are available, these companies can easily determine whether their products are to an extent fit to be reused.

8.4 Limitations

During the research period, it became apparent that not all the information that was required to develop a DST to evaluate the reusability of glass wine bottles could be obtained. The confidentiality of the information for this research also limited the extent to which the research could be conducted and shared in the wine industry. The researcher also identified more parameters to evaluate the reusability of glass wine bottles than were used within the DST as discussed in Section 5.5.2. Two of the parameters that were regarded as relevant in theory but are not included in this research are the 'season variation in demand' and the 'cycle time'.

The season variation in demand parameter determines the amount of excess inventory a company should have in storage to manage the increase demand during seasonal times. One of Distell's decision makers stated that the season variation in demand is relatively consistent throughout the year in most brands and that it does not sincerely effect their decision on whether to reuse a bottle. The cycle time parameter requires the data on the time between the supplier and customer. The information was not available and difficult to obtain. Further investigation into these two parameters is considered as a future recommendation for research that builds on the outcome of this thesis.

More information on the 'level of standardisation' parameter was also required to increase the validity of the DST. The outcome was limited to the number of SKUs that were traded within a brand. An ideal outcome would have been to study the parameter more in-depth by acquiring data on the number of sales within each SKU of a brand. By doing this, a more realistic level of standardisation would have been obtained from the DST since significantly more sales in one of a brand's SKUs will increase the overall level of standardisation of the brand. However, this information could not be acquired from the case company.

The limitations on the parameters discussed above is to some extent a result of having conducted the research with only one company in the wine industry along with their unique setting. Doing this increased the risk of conducting a valid and complete research while limiting the significance of the research's outcome for the broader wine industry. Another disadvantage that the researcher experienced by cooperating with only one company in a unique setting was their devotion to fully participate in the research. The main reason for this relates to the researcher reaching out to the case company instead of the case company requiring research into such a topic. The decision makers from the case company did agree to participate in the research and to share the required data under an NDA, but the acquisition of data did take a considerable amount of time, which delayed the research by several months.

The limitations experienced during the research also restricted the generalisability of the outcomes to the broader wine industry of South Africa. When considering the number of bottles sold, other wine companies will require higher wine sale volumes than those required by Distell to justify the recovering and reusing activities because Distell accumulates their empty wine bottles with all their reusable spirits, ciders and RTD product lines. Doing this reduces Distell's per-unit cost of recovering and reusing wine bottles.

If more wine companies in South Africa could use the DST directly from this research, it could allow them to evaluate whether their glass wine bottles are viably reusable from a business logistics perspective. Doing this could lead to companies considering to co-operate and invest in the required infrastructure to accommodate the recovering and reusing of their glass wine bottles. This will create the required economies of scale to viably reuse and recover their wine brands while increasing the wine industry's contribution towards environmentally sustainable business.

8.5 Recommendations

From the findings, it would be recommended that Distell allows the foreseeable growth of Brand X to realise and increase the wine bottle's overall level of reusability until Brand X is more on par with the reusable glass wine bottles' level of reusability. While the increase in sales is realising, Distell should commence with a cost-benefit analysis to determine whether it makes economic sense to reuse Brand X on a commercial scale. An environmental impact study should also be conducted to determine the potential effect of reusing Brand X could have on the environment if it would be reused.

It is recommended that wine companies in the broader industry of South Africa use the DST to evaluate the reusability of their glass wine bottles by comparing their data with Distell's data even if they do not have the required infrastructure. It can be done without compromising Distell's data. It would provide wine companies in South Africa with a fast and cost-effective way to determine whether their glass wine bottles are in line with Distell's reusable glass wine bottles.

The limitations of this research also provide opportunities for future academic research to be conducted to improve on the developed DST. Even though the DST provided an outcome on whether to reuse Brand X, the opportunities for research still exist to increase the generalisability of the model for the broader wine industry, adding more and relevant parameters to the DST and developing similar models from different perspectives.

The input parameters of the DST are not limited to the ones discussed within this research. From a business logistics perspective, the 'season variation in demand' and 'cycle time' parameters can be added if the data are available as well as more in-depth data on the level of standardisation as discussed in the limitations subsection. It is also recommended to add more participants from the relevant departments in the case company to contribute to the weight attribution of the DST.

The estimated returns per province was a stand-alone parameter in the research to indicate whether there is an alignment between a region's return rate and the number of a brands' bottles sold in the same region. The parameter had shortcomings concerning the lack of specific data within the three identified regions in South Africa. Information that is more detailed can increase the validity and reliability of the parameter's outcome. The specific data can provide a realistic indication on whether certain areas where a non-reusable brand is being sold have good return rates with similar reusable products.

If Distell considers reusing Brand X's bottles in practice, more research is required from different perspectives. The first recommendation is to provide an economic perspective by performing a cost-benefit analysis to indicate the financial implication of reusing Brand X. The second is an environmental impact study of the extent to which reusing Brand X will contribute to environmental sustainability. The final perspective is research from an optimisation perspective by developing a linear programming model to calculate the amount of Brand X's glass wine bottles that should be recovered to be viably reusable from a financial perspective.

8.6 Concluding remarks

The outcome of the research was a functional DST that provided a way to evaluate the reusability of glass wine bottles from a business logistics perspective. As discussed earlier, the outcome of this research is the first of various tests and evaluations that a non-reusable bottled brand must undergo before a conclusion can be reached on whether to reuse its bottles in practice. This is due to high level of complexity that is involved when attempting to reuse a bottle that is currently not reusable.

When a wine company wants to determine whether their products are suitable for returnable packaging, they should initially consider whether the circumstances of the products are aligned for being reused within the South African context, represented by the qualitative parameters identified within this thesis. When they want to determine the viability of the product to be reused,

the quantitative parameters of the product needs to be evaluated and compared to products that are already being reused to derive at a valid and reliable outcome.

An ideal outcome of this research would have been to increase the generalisability of the DST in order to share it across the broader wine industry. This would have allowed more companies to benefit from using the DST to reliably evaluate their own non-reusable brands. However, since the frameworks that were followed provided a valid and reliable outcome, other companies can adjust the DST of this research to fit their unique circumstances to provide an outcome on whether their non-reusable brands are viably reusable from a business logistics perspective.

A main focus of the research was to develop it in the most user-friendly way. This allows for swift changes and additions to be made to the DST if it would be required from the decision makers. More parameters can be added in the future to the DST to derive at a more holistic and thorough outcome concerning a brand's level of reusability. The user-friendliness of the DST also allows it to be used within Distell to be applied to their other product categories such as the spirits, ciders and RTDs.

The flexibility and additional usages for the DST is a result of strictly following the research methodology and decision support tool development frameworks provided by literature. Any research that would build on the opportunities deriving from this research has the advantage of a strong platform laid by this research.

References

Antrobus, S. 2016. Personal interview. 6 May, Parow.

Beverage Review. 2015. *Consumers opt for sustainable products* [Online]. Available: http://reference.sabinet.co.za.ez.sun.ac.za/webx/access/electronic_journals/im_safr/im_safr_v42_n1_a11.pdf. [2015, September 9].

Busch, J. 1987. Second time around: A look at bottle reuse. *Historical Archaeology*, 21(1):67-80.

Cambridge Dictionary. 2017. *Meaning of "viable" in the English Dictionary* [Online]. Available: http://dictionary.cambridge.org/dictionary/english/viable. [2017, September 22].

Carter, C.R. & Ellram, L.M. 1998. Reverse logistics: A Review of the literature and framework for future investigations. *Journal of Business Logistics*, 19(1):85–102.

Coca-Cola FEMSA. 2000. *2000 Annual Report*. Washington, DC: Coca-Cola FEMSA.

Conningarth Economists. 2015. *Macro-economic impact of the wine industry on the South African economy*. Pretoria: Conningarth Economists.

Cox, N.J. 2007. *Transformations: an introduction* [Online]. Available: http://fmwww.bc.edu/repec/bocode/t/transint.html. [2017, July 25].

De Brito, M.P. 2004. *Managing reverse logistics or reversing logistics management?* Published doctoral dissertation. Rotterdam: Erasmus University Rotterdam.

Demeter, K. & Matyusz, Z. 2011. The impact of lean practices on inventory turnover. *International Journal of Production Economics*, 133(1):154–163.

Denscombe, M. 2007. *The good research guide for small-scale research projects*. Glasgow: Bell and Bain Ltd.

Distell Group Ltd. 2015. *Integrated Report 2015*. Stellenbosch: Distell Group Ltd.

Distell Group Ltd. 2016a. *Integrated Report 2016*. Stellenbosch: Distell Group Ltd.

Distell Group Ltd. 2016b. *Sustainability Report 2016*. Stellenbosch: Distell Group Ltd.

Dowlatshahi, S. 2000. Developing a theory of reverse logistics. *Interfaces*, 30(3):143–155.

Down to Earth: Returnable bottles: a new informal economy is emerging [Online]. 2014. Available: http://downtoearth.danone.com/2014/07/30/returnable-bottles-a-new-informal-economy-is-emerging/. [2016, October 26].

Euromonitor International: *Cider/Perry in South Africa* [Online]. [n.d.]. Available: http://www.euromonitor.com/cider-perry-in-south-africa/report. [2016, June 15].

Euromonitor International: Wine in South Africa [Online]. 2015. Available: http://www.euromonitor.com/wine-in-south-africa/report. [2016, February 9].

Ferguson, N. & Browne, J. 2001. Issues in end-of-life product recovery and reverse logistics. *Production Planning & Control*, 12(5):534–547.

Fleischmann, M., Bloemhof-Ruwaard, J.M., Dekker, R., van der Laan, E., van Nunen, J.A.E.E. & Van Wassenhove, L.N. 1997. Quantitative models for reverse logistics: A review. *European Journal of Operational Research,* 103(1):1–17.

Forest, P.G., Marchildon, G.P. & McIntosh, T. 2004. *Changing health care in Canada.* Toronto: University of Toronto Press.

Fuhrmann, R.C. 2014. *Inventory turnover* [Online]. Available: http://www.investopedia.com/ask/answers/070914/how-do-i-calculate-inventory-turnover-ratio.asp. [2016, May 20].

Garcia, F.A., Marchetta, M.G., Camargo, M., Morel, L. & Forradellas, R.Q. 2012. A framework for measuring logistics performance in the wine industry. *International Journal of Production Economics,* 135(1):284–298.

Golding, A. 1998. *Reuse of primary packaging: Final report*. Tübingen: University of Tübingen.

Gooley, T. 1998. *Reverse logistics steps to success: Logistics Management and Distribution Report.* [S.n.: s.l.].

Haas, D.A., Murphy, F.H. & Lancioni, R.A. 2003. Managing reverse logistics channels with data envelopment analysis. *Transportation Journal,* 4(3):59–69.

Heyns, R. 2013. *Packaging companies adapt to survive*. [Cape Town]: Kagiso Asset Management (Pty) Ltd [Online]. Available: http://www.kagisoam.com/wp-content/uploads/2013/06/Packaging-companies-adapt-to-survive.pdf. [2017, May 9].

Incpen. 2010. *Reusable Packaging* [Online]. Available: http://www.incpen.org/displayarticle.asp?a=5&c=2. [2016, April 21].

Jayaraman, V., Ross, A.D. & Agarwal, A. 2008. Role of information technology and collaboration in reverse logistics supply chains. *International Journal of Logistics Research and Applications,* 11(6):409–425.

Jhetam, S. 2016. Personal interview. 11 February, Stellenbosch.

Kärkkäinen, M., Ala-Risku, T. & Herold, M. 2004. Managing the rotation of reusable transport packaging - a multiple case study. *Eighth International Working Seminar on Production Economics*. 16-20 February, Innsbruck, Austria [Electronic]. Available: http://legacy-tuta.hut.fi/logistics/publications/Managing_package_rotation_IGLS.pdf. [2016, August 24].

Karstel, E. 2016. Personal interview. 2 July, Epping.

Ko, Y.D., Noh, I. & Hwang, H. 2012. Cost benefits from standardization of the packaging glass bottles. *Computers & Industrial Engineering,* 62(3):693–702.

Kopicki, R., Berg, M.J., Legg, L. & Poist, R.F. 1993. Reuse and recycling - reverse logistics opportunities. *Transportation Journal*, 34(3):64–65.

Kotze, M. 2016. Personal interview. 20 January, Durbanville.

Kroon, L. & Vrijens, G. 1995. Returnable containers: an example of reverse logistics. *International Journal of Physical Distribution & Logistics Management*, 25(2):56–68.

Leighton, C.E. 2010.*Refillable wine bottles* [Online]. Available: http://www.solidwastemag.com/features/refillable-wine-bottles/. [2015, November 13].

Linton, J.D. & Johnston, D.A. 2000. Remanufacturing at Nortel Networks. *Interfaces*, 30(6):17–31.

Mettyear, D. 2015. *Domestic Volume Report 2015*. London: International Wines and Spirits Record.

Mettyear, D. 2016. *Domestic Volume Report 2016*. London: International Wines and Spirits Record.

Mollenkopf, D., Closs, D., Twede, D., Lee, S. & Burgess, G. 2005. Assessing the viability of reusable packaging: A relative cost approach. *Journal of Business Logistics,* 26(1):169–197.

Morse, G. 2016. Personal interview. 10 February, Stellenbosch.

Mouton, J. 2001. *How to succeed in your Master's & Doctoral Studies*. Pretoria, Van Schaick.

Myers, M.D. 2003. *Qualitative research in information systems* [Online]. Available: www.qual.auckland.ac.nz. [2016, June 8].

Nuss, C., Sahamie, R. & Stindt, D. 2015. The reverse supply chain planning matrix: A classification scheme for planning problems in reverse logistics. *International Journal of Management Reviews*, 17(4):413–436.

Office of Technology Assessment Materials Group. 1979*. Materials and energy from municipal waste*. Washington, DC: Office of Technology Assessment Materials Group.

Pålsson, H. 2016. Personal interview. 4 April, Stellenbosch.

Platt, B. & Rowe, D. 2002. *Reduce, reuse, refill!* Washington, DC: Institute for Local Self-Reliance.

Power, D.J. 2002. *Decision support systems: Concepts and resources for managers*. London: Quorum Books Division Greenwood Publishing.

Power, D.J. 2011. *Decision support systems resources* [Online]. Available: http://dssresources.com/. [2016, May 5].

Power, D.J., Sharda, R. & Burstein, F. 2002. Decision support systems. *Journal of the Royal Society of Medicine*, 93(12):629–633.

Rong, F. 2012. Understanding developing country stances on post - 2012 climate change negotiations: Comparative analysis of Brazil, China, India, Mexico and South Africa. *Energy Policy*, 38(8):4582–4591.

SABMiller plc. 2015. *Sustainable development summary report 2012.* [S.n.: s.l.].

Saphire, D. 1996. Case reopened: Reassessing refillable bottles. *Journal of Hazardous Materials,* 48(3):266–272.

Saunders, M., Lewis, P. & Thornhill, A. 2009. *Research methods for business students*. Farnborough: Rotolito Lombarda.

Sauter, V.L. 2011. *Decision support systems for business intelligence*. St. Louis: John Wiley & Sons.

SAWIS. 2015. *SAWIS annual statistics* [Online]. Available: http://www.wosa.co.za/The-Industry/Statistics/Sawis-Annual-Statistics/. [2015, August 17].

SAWIS. 2017. *SA Wine Industry 2016 Statistics Nr 41*. Paarl: SAWIS.

Smith, B. 2016. Personal interview. 10 February, Stellenbosch.

Sprague, R.H. & Carlson, E.D. 1982. *Building effective decision support systems.* Englewood Cliffs, NJ: Prentice-Hall.

Sprague, R.H. & Watson, H.J. 1996. *Decision support for management*. Upper Saddle River, NJ: Prentice-Hall.

Stock, J.R. 1998. *Development and implementation of reverse logistics programs*. Oak Brook: Council of Logistics Management.

Taticchi, P., Garengo, P., Nudurupati, S.S. & Tonelli, F. 2015. A review of decision-support tools and performance measurement and sustainable supply chain management. *International Journal of Production Research,* 53(21):6473–6494.

Tennant, J. & Friend, G. 2005. *Guide to business modelling.* London: Legoprint.

TGRC. 2013. *Annual Review 2013*. Johannesburg: TGRC.

Theron, C. 2013. *WineLand magazine - Integrated production of wine – the management of solid waste* [Online]. Available: http://www.wineland.co.za/technical/integrated-production-of-wine-ipw-–-the-management-of-solid-waste. [2016, October 25].

Thierry, M. 1995. Strategic issues in product recovery management. *California Management Review*, 37(2):114–135.

User, S. 2017. *Distell's new wine blend* [Online]. Available: http://www.cbn.co.za/index.php?option=com_k2&view=item&id=5464:distell-s-new-wine-blend&Itemid=373. [2017, June 23].

Van den Berg, D. 2016a. Personal interview. 12 January, Stellenbosch.

Van den Berg, D. 2016b. Hergebruik van wynbottels, e-mail to F. Adriaanse [Online], 16 February. Available e-mail: djvdberg@distell.co.za.

Van den Berg, D. 2017. Data feedback, e-mail to F. Adriaanse [Online], 21 July. Available e-Mail: djvdberg@distell.co.za.

Van Wyk, B. 2012. *Research design and methods Part I*. Bellville: University of Western Cape.

Venkatesh, V., Punjabi, L., Gupta, V., Patil, S. & Kadam, R. 2013. Returnable container collection process in reverse supply chain operations: A case study of an Indian distillery company. *Journal of Supply Chain Management Systems*, 2(2):1–19.

Who's who. 2010. *Distell extends its glass recycling project* [Online]. Available: http://whoswho.co.za/company/news/354814. [2016, March 2].

Wilson, D. 2015. *Strategic decision making*. [S.n.: s.l.].

Wine Net. 2010. *Distell's new glass saving project to augment light-weighting campaign* [Online]. Available: http://www.wine.co.za/news/news.aspx?NEWSID=16085. [2016, March 2].

WOSA. 2015. *Overview* [Online]. Available: http://www.wosa.co.za/The-Industry/Overview/. [2015, September 4].

WOSA. 2016. *Sustainable wine South Africa* [Online]. Available: http://www.wosa.co.za/Sustainability/Environmentally-Sustainable/Sustainable-wine-South-Africa/ [2017, Augustus 30].

Yin, R.K. 2014. *Case study research: Design and methods*. Los Angeles, CA: SAGE Publications Ltd.

Zhang, Y. & Barbara, W.M. 2009. *Applications of social research methods to questions in information and library science*. Westport, CT: Libraries Unlimited.

Appendices

Appendix A – Interviews conducted throughout the research

Table A.1: Summary of interviews conducted for research

Position of interviewee	Company name	Industry	Type of interview	Date of interview	Place of interview	Topic of interview
Business Improvement Manager	Distell Ltd.	Wine, Spirits, Ready-to-drinks and ciders	Personal, Semi-structured	12/01/2016	Stellenbosch	Distell's experience with reusing wine bottles
Chief Executive Officer	The Glass Recycling Company (TGRC)	Glass Recycling	Telephone, Semi-structured	11/02/2016	Stellenbosch	TGRC's contribution to reusing and recycling glass bottles
Service Manager	Distell Ltd.	Wine, Spirits, Ready-to-drinks and ciders	Personal, Semi-structured and unstructured	06/05/2016	Distell's Sorting Facilities, Parow	Factors to consider when implementing a new bottle for reusing
Washing Plant Manager	Distell Ltd.	Wine, Spirits, Ready-to-drinks and ciders	Personal, Semi-structured and unstructured	02/06/2016	Distell's Washing plant, Epping	Factors to consider when implementing a new bottle for reusing
Secondary Distribution Planning Manager	South African Breweries (SAB)	Beer	Telephone, Semi-structured	10/02/2016	Stellenbosch	SABMiller's experience with reusable bottles
Manufacturing Director	The Coca-Cola company	Soft Drink	Telephone, Semi-structured	29/03/2016	Stellenbosch	Coca-Cola's experience with reusing glass bottles in South Africa
Chief Executive Officer	Namaqua Wines	Wine	Personal, Semi-structured	27/12/2015	Strandfontein	Reusing glass wine bottles in South Africa
Marketing and Sales director	Leopards Leap Wines	Wine	Personal, Semi-structured and unstructured	20/01/2016	Durbanville	View on middle and upper class wine's for standardisation and reusing

Appendix B – Pages from the online survey to provide each quantitative parameter with a weight attribution

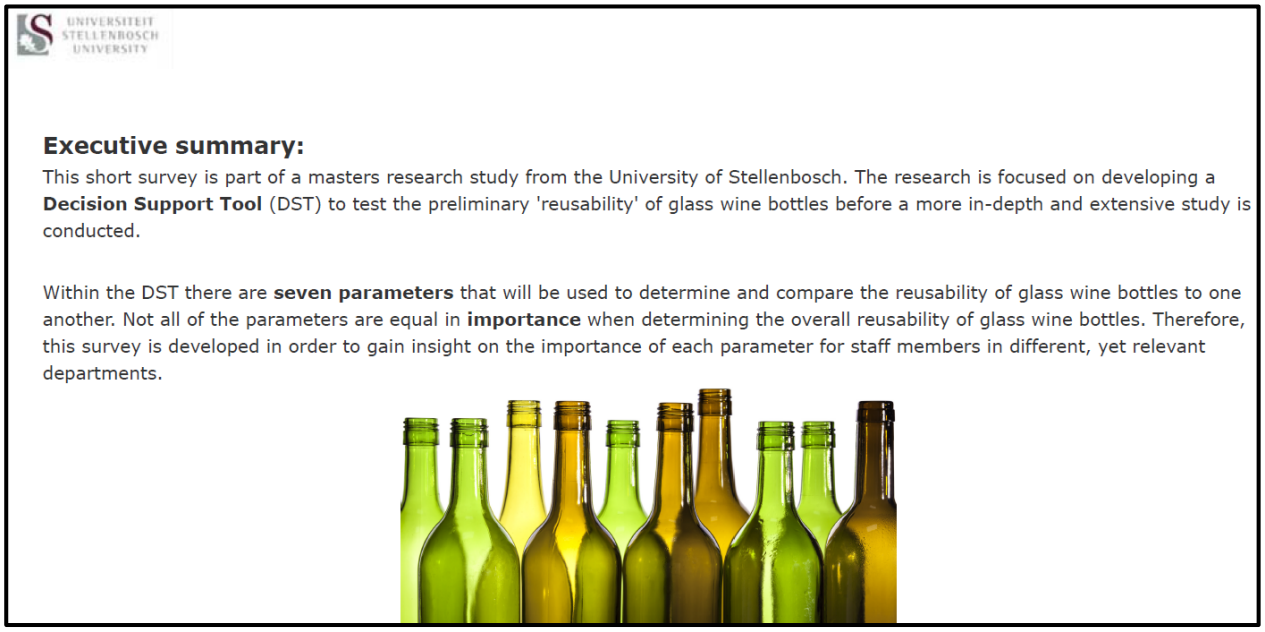
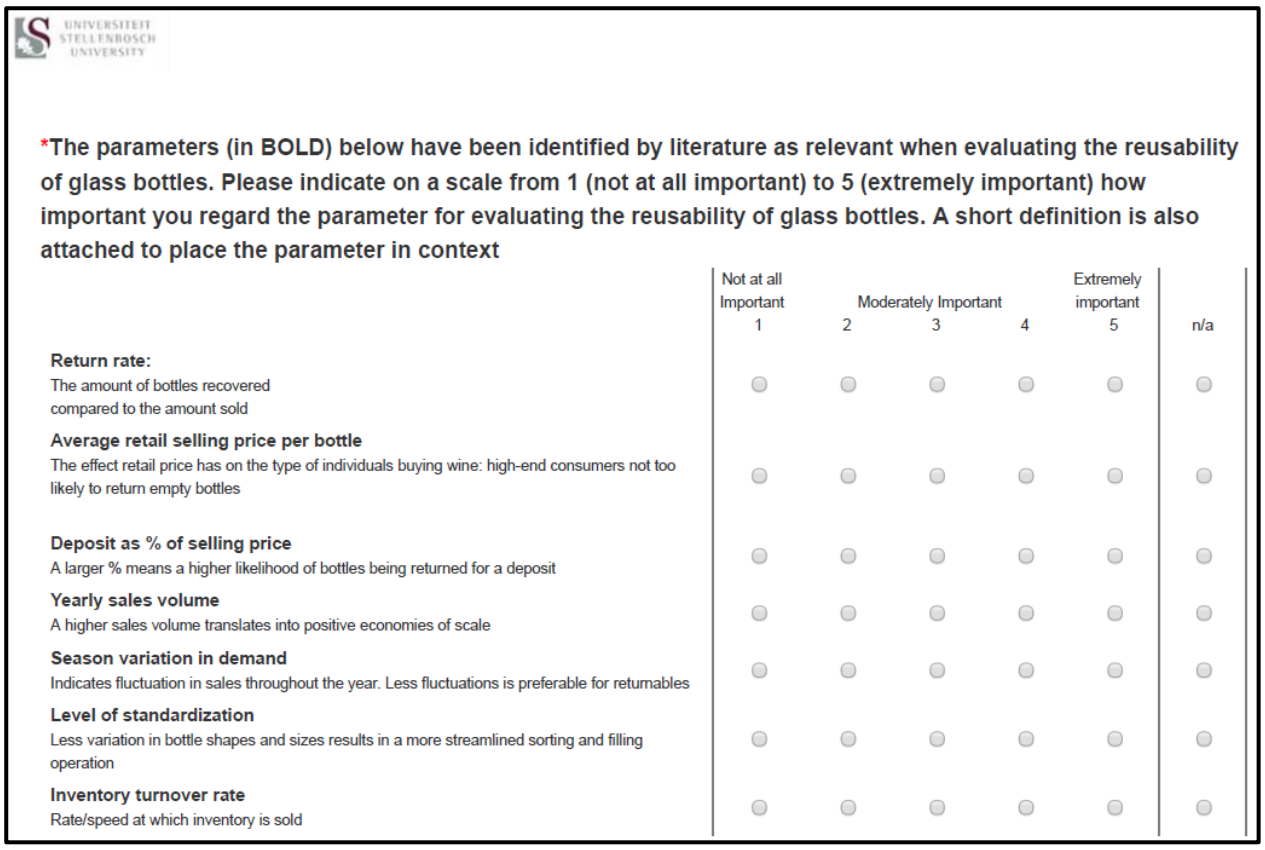


Figure B.1 Online survey page one - Executive summary to inform participants of the research as well as the desired outcome of the survey

Figure B.2: Online survey page two - Each participant was required to select from a drop down list which department they are working in



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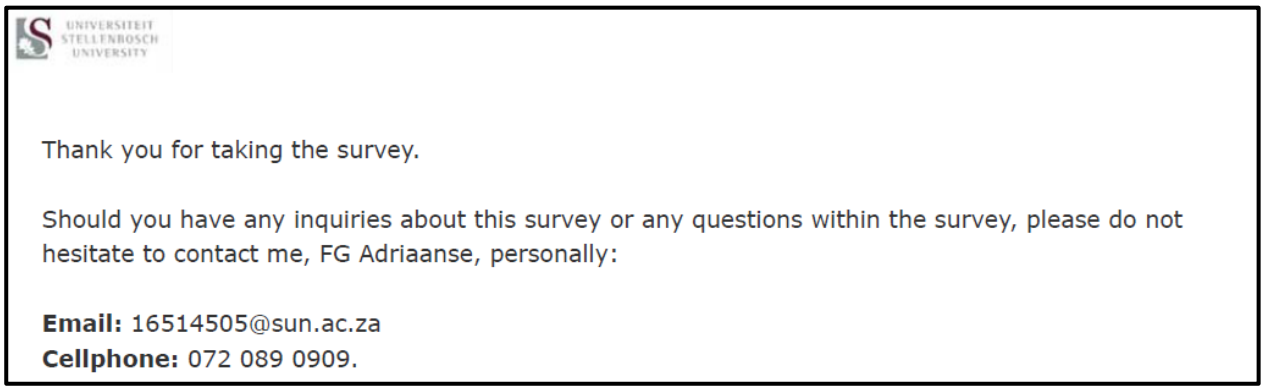
*The parameters (in BOLD) below have been identified by literature as relevant when evaluating the reusability of glass bottles. Please indicate on a scale from 1 (not at all important) to 5 (extremely important) how important you regard the parameter for evaluating the reusability of glass bottles. A short definition is also attached to place the parameter in context

	Not at all Important 1	2	Moderately Important 3	4	Extremely important 5	n/a
Return rate: The amount of bottles recovered compared to the amount sold	○	○	○	○	○	○
Average retail selling price per bottle The effect retail price has on the type of individuals buying wine: high-end consumers not too likely to return empty bottles	○	○	○	○	○	○
Deposit as % of selling price A larger % means a higher likelihood of bottles being returned for a deposit	○	○	○	○	○	○
Yearly sales volume A higher sales volume translates into positive economies of scale	○	○	○	○	○	○
Season variation in demand Indicates fluctuation in sales throughout the year. Less fluctuations is preferable for returnables	○	○	○	○	○	○
Level of standardization Less variation in bottle shapes and sizes results in a more streamlined sorting and filling operation	○	○	○	○	○	○
Inventory turnover rate Rate/speed at which inventory is sold	○	○	○	○	○	○

Figure B.3: Online survey page 3 - The various identified quantitative parameters with a scale ranging from 1-5. A short definition of each parameter is included underneath the parameter's name



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Thank you for taking the survey.

Should you have any inquiries about this survey or any questions within the survey, please do not hesitate to contact me, FG Adriaanse, personally:

Email: 16514505@sun.ac.za
Cellphone: 072 089 0909.

Figure B.4: Online survey page 4 - Contact details of the researcher in case there is uncertainty or other questions from the participant

Appendix C – DST Microsoft Excel input templates

Table C.1: Input template requiring all input data from reusable brands. The blue shaded fields are linked within the rest of the DST's input parameters

Five currently returnable wine brands	Number of bottles sold 2015 (CY/FY)	Number of bottles recovered	Deposit per bottle (ZAR)	Average retail selling price per bottle (ZAR)	Average COGS 2015	Average inventory value for 2015	Number of SKU's within brand
Example Brand	570 661	378 103	R 2.50	R 32.00	R 6 428 548.63	R 684 793.12	2

Table C.2: Evaluation input template for the brand under consideration. The blue shaded fields are linked within the rest of the DST's input parameters

Brand under consideration	Number of bottles sold in FY	Deposit per bottle (ZAR)	Average retail price per bottle (ZAR)	Average COGS	Average inventory value	Number of SKU's within brand
Example brand	*1 365 894*	*R 1.54*	*R 28.58*	*R 25 839 574*	*R 18 570 285*	*2*

Table C.3: Weight attribution input template. Blue shaded cells require data to be entered from online survey

	Department's weight attribution						
Parameter	**Marketing**	**Business Improvement**	**Distribution**	**Other**	**Distribution**	**Average**	**Converted Average**
Return rate							
Average retail price per bottle							
Deposit as % of selling price							
Number of bottles sold							
Level of standardisation							
Inventory turnover rate							

Appendix D – DST Microsoft Excel parameters input template

Table D.1: Return rate parameter input template with a minimum required return rate of 80% included. Blue shaded cells are linked to the main input data

Brand	Number of bottles sold 2015 (FY)	Number of bottles recovered	Return rate	Score
A				
B				
C				
D				
E				
Min requirement			**0.80**	
Sum			**0.80**	

Table D.2: Average retail price input template. Blue shaded cells are linked to the main input data

Brand	Avg retail price	Reciprocal value	Score
A			
B			
C			
D			
E			
Brand X			
Total			

Table D.3: Deposit as a percentage of selling price input temple with a minimum requirement of 3%. Blue shaded cells are linked to the main input data

Brand	Deposit amount (ZAR)	Product's Average Retail Price (ZAR)	Deposit as % of Selling	Score
A				
B				
C				
D				
E				
Brand X				
Min Requirement			**3.00%**	
Total				

Table D.4: Number of bottles sold input parameter. Blue shaded cells are linked to the main input data

Brand	Latest financial year	Score
A		
B		
C		
D		
E		
Brand X		
Total	**0**	

Table D.5 Level of standardisation input parameter. Blue shaded cells are linked to the main input data

Brand	Number of SKU's within brand	Reciprocal value	Score
A			
B			
C			
D			
E			
Brand X			
Total	**0**	**0.00**	

Table D.6: Inventory turnover rate input parameter. Blue shaded cells are linked to the main input data

Brand	Cost of goods sold (ZAR)	Average Inventory (ZAR)	Inventory turnover rate	Score
A				
B				
C				
D				
E				
Brand X				
Total			**0.00**	

Table D.7: Estimated returns per province input parameter

Region	Coastal	Central & Northern	South	Total
Total number of reusable wine bottles sold				
Total number of reusable wine bottles recovered				
Return rate per region				
Number of Brand X bottles sold				
Estimated returns of Brand X bottles				
Brand X estimated return rate				

Appendix E – DST Microsoft Excel output template

Table E.2: DST output parameter template. Blue shaded cells are linked to the input parameters

Brand	Parameter	Weight	Score	Total score
A	Return rate			
A	Average retail price per bottle			
A	Deposit as % of selling price			
A	Number of bottles sold			
A	Level of standardisation			
A	Inventory turnover rate			
A	**Level of reusability**			
A	**Level of reusability excluding return rate**			
B	Return rate			
B	Average retail price per bottle			
B	Deposit as % of selling price			
B	Number of bottles sold			
B	Level of standardisation			
B	Inventory turnover rate			
B	**Level of reusability**			
B	**Level of reusability excluding return rate**			
C	Return rate			
C	Average retail price per bottle			
C	Deposit as % of selling price			
C	Number of bottles sold			
C	Level of standardisation			
C	Inventory turnover rate			
C	**Level of reusability**			
C	**Level of reusability excluding return rate**			
D	Return rate			
D	Average retail price per bottle			
D	Deposit as % of selling price			
D	Number of bottles sold			
D	Level of standardisation			
D	Inventory turnover rate			
D	**Level of reusability**			
D	**Level of reusability excluding return rate**			
E	Return rate			
E	Average retail price per bottle			
E	Deposit as % of selling price			
E	Number of bottles sold			
E	Level of standardisation			
E	Inventory turnover rate			
E	**Level of reusability**			
E	**Level of reusability excluding return rate**			
Brand X	Average retail price per bottle			
Brand X	Deposit as % of selling price			
Brand X	Number of bottles sold			
Brand X	Level of standardisation			
Brand X	Inventory turnover rate			
Brand X	**Level of reusability excluding return rate**			